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Home Audit Program:
Management Manual

Prepared for:
U.S. Department of Energy
Economic Regulatory Administration
Office of Utility Systems
Under Grant No. FG 01-79RG 10027

September 1980

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Prepared by:
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Washington, D.C. 20037
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Office of Utility Systems
Washington, D.C. 20461

FOREWORD

Only about 50 local public power systems are above the threshold level of participation in the National Energy Conservation Policy Act (750 million kwh sales annually). Many of these utilities have ongoing conservation programs which will be modified to fit within the framework of NECPA.

The remainder of the nation's 2,200 local public power systems and, more importantly, the communities they serve, are not directly impacted by the law. While these smaller public power systems may be exempt from the specific provisions of NECPA, they are not insulated from the impact of the new law. Communications media today – radio, television, newspapers – are not limited to one utility's service area. Customers of a small public power system may well want to know why other residents of the area are receiving energy conservation assistance that they are not.

As the nation shifts from a promotional to a conservative use of energy, consumer-owned utilities will play a major role in helping their customers make this adjustment. As energy prices rise, homeowners will naturally seek out their local utilities for information, advice, and professional services. Public power systems thus have the opportunity to be leaders, to guide homeowners into a new era of energy efficiency.

That kind of leadership will not need to wait for a federal mandate from Washington. Walt Canney, utilities administrator at Lincoln, Nebraska, put it this way: "I think that if we are to survive in the eighties that we're going to have to take a hard look at spending the time, the money, and the dedicated effort to develop an appropriate conservation program for our communities that includes conservation assistance to customers. I can't specify what the breadth of that program should be nor that it must be the same in every community, but I am sure that an effort must be made not only in the interest of public power survival, but in the legitimate national interest of energy conservation and in the interest of our customers to reduce their electric bills."

Canney brushes aside objections from public power systems that feel they are too small to have conservation programs: "I know that it is easy to say that our smaller cities 'can't afford' to put on full or part-time people to assist with energy conservation, to discuss our rates and overall operations regularly with our public and our rate payers, and to lend our voice to improvement, clarification, or modification of state or federal regulations because we're too small and it costs too much."

"I have one suggestion on survival in the eighties for municipal electric systems. That suggestion is: we can't afford *not* to."

Many public power systems – large and small – have initiated home energy audit programs in response to the requests of their consumers. Larger public power systems like Seattle, Washington, or the Tennessee Valley Authority regard energy conservation as a supply source and are investing accordingly. Small public power systems have managed to substitute ingenuity and hard work for large staffs and budgets to produce home audit programs particularly appropriate for the communities they serve.

On one point there is general agreement: whether analyzed from a consumer or a utility viewpoint, the economics of energy conservation are impressive. Recent estimates indicate that construction costs for an 1,100 megawatt nuclear unit scheduled to go into operation in 1992 could range as high as $2,700 per kilowatt (kw) installed. With those kinds of costs, and the extended length of time necessary to complete a project, it is not surprising that utility planners are seeking to save kw where they can. Seattle City Light has targeted a 250 megawatt reduction by 1990. The Tennessee Valley Authority, by the same year, expects total capacity savings of between 4,843 and 7,391 megawatts.

Philosophically, as Palo Alto Utilities Director Edward K. Aghjayan put it: "Every unit of energy saved now through conservation means that one will be available in the future; one less therm of natural gas taken from the ground or one less kilowatt hour of power produced from thermal power plants now, reserves these resources for future needs. Thus, the long-term effect of energy conservation will not only be favorable economically, but will ensure that such resources will be available at all."

It is the purpose of this project, sponsored by the American Public Power Association and funded by APPA and the United States Department of Energy, to provide smaller public power systems with the information and specific skills needed to design and develop a program of residential energy audits. The program was based on the following precepts:

1. Locally owned public power systems are the best, and in many cases, the only agencies available to organize and coordinate energy conservation programs in many smaller communities.

2. Consumers' rights to energy conservation information and assistance should not hinge on the size of the utility that serves them.

3. In the short run, public power systems of all sizes should offer residential energy conservation assistance to their consumers, because such assistance is desirable, necessary, and in the public interest.

4. In the long run, such programs will complement national energy goals and will produce economic benefits for both consumers and the public power system.

This manual is a detailed description of home audit program planning, organization, and management, with a number of reference appendices attached. It was reviewed for technical content by a panel of conservation staff specialists from public power utilities.

Case histories have been included because many public power systems generously agreed to share their experience – and mistakes – for the benefit of those utilities now in the process of developing their own programs.

With special thanks to:

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PLANNING

This section of the manual will show a small utility staff how to develop a plan for a Home Audit Program. The planning process involves a number of steps, all of which can be performed by the staff of a small utility. The recommended planning procedures have been developed, tested, and refined in actual field experience. They may seem unnecessarily detailed at first, but systematic attention to detail in planning can often avoid years of program operating headaches.

Remember that program paperwork will be repeated on hundreds of homes. Eliminating an unnecessary form does not mean eliminating a single piece of paper – it means eliminating hundreds of pieces of paper.

The *Planning* procedure consists of five activities:

I. Establishing Utility Goals and Identifying Resources

II. Assessing the Capabilities of Contractors and Banks

III. Developing the Energy Audit

IV. Planning a Public Communications Campaign

V. Writing a Program Plan

Each of these activities is discussed in detail with references to materials contained in the appendices at the end of the manual.

I. ESTABLISHING UTILITY GOALS AND IDENTIFYING RESOURCES

To establish a Home Audit Program, a utility must decide what the program should accomplish and then what tools are needed to reach the audit goals. These tasks are described in the next few pages, which are followed by suggested summary planning forms.

Defining Reasonable Goals

The task for defining reasonable goals for a utility Home Audit Program involves estimating the number of homes to be served, the energy conservation expected to result from the Home Audit Program, and the impact of this conservation on utility load and revenues.

Homes to be Served

A utility must estimate as accurately as possible the number of homes which will need and request Home Audit Program services. This estimate is best established using the experience of the utility with similar types of programs, if there have been any. Appliance and/or electric heat consultation services have been offered in the past by many utilities, and are probably the closest historical approximation to the Home Audit Program. Any participation figures of percentages from past programs should be researched and recorded.

These percentage figures can then be compared to the total number of houses served by the utility. A utility usually keeps very accurate records of the residential customers it serves.

It is also necessary for the utility to take into account the age and general condition of the houses to be served by the Home Audit Program. In some parts of the country, the housing is generally older. Typically, older houses are inadequately insulated, drafty, and heated with obsolete equipment. Newer homes are often much more energy efficient. In this first planning task, it is necessary for the utility to make a rough guess of the general condition of its customers' houses, in order to help predict the potential demand for Home Audit services.

Sources of possible information are municipal records, generally kept in the building, planning, or taxation offices; the census of housing records, kept by the Bureau of the Census, U.S. Department of Commerce, and published in separate volumes for each state; and the records kept for the 701 Planning Grant program administered by the U.S. Department of Housing and Urban Development (HUD).

Expected Energy Conservation

A utility must estimate the energy conservation which will result from its Home Audit Program. This conservation estimate is useful in two ways:

- It provides the basic justification for the Home Audit Program.
- It allows the utility to prepare for any significant changes in load or revenue which may result from the Home Audit Program.

A conservation estimate is constructed by determining what savings are possible in a house, how many houses will implement the suggested conservation measures, and which fuels will be conserved.

The potential savings from a conservation program in a house are substantial. Ranges of estimates and references to various government and private industry residential conservation programs are contained in Appendix A. As an introduction to the subject, consider the experience of the Department of Energy-funded research on a townhouse development, in which a series of minor conservation improvements, totalling a few hundred dollars, reduced the existing fuel bills of the townhouses as much as seventy percent.

Determining how many houses will implement conservation measures is not difficult. All will. The question is when. As fuel prices increase, all homeowners will implement the conservation measures which make sense. Unfortunately, very little data is available at the moment on the exact trigger mechanisms which motivate homeowners. Estimating improvement schedules would be easy if there were graphs which indicated, for example, that at a certain price per heating Btu, homeowners insulated their attics. But it's not that easy. Guesses on the rate of fuel price increases, the responsiveness of local homeowners, and the money homeowners have available for conservation investments, must be integrated into a rough estimate.

Determining which fuels will be conserved is a matter of knowing what the percentages of local heating fuel use are, and whether there are significant differences in existing conditions between houses which heat with different fuels. For instance, a utility may find that it has equal numbers of houses that heat with electricity and oil. However, the potential savings of oil might be much greater because the electrically heated homes are newer or were previously reinsulated when electric heat was installed.

Impact on Utility Load/Revenues

If, in assembling the conservation estimate, it appears that the Home Audit Program may have a significant impact on utility load, additional, detailed research may be necessary. This research is somewhat complicated because it involves a number of different factors:

- Demand, especially on peak.
- Total kwh consumed.
- Revenue effects, both in gross dollars and rate structures.

Some public power systems find it helpful to distinguish between "permanent" energy-saving measures that, once installed, save energy all the time and can't be by-passed, and "temporary" measures. These "permanent" measures would be ceiling, wall and floor insulation, storm windows and caulking, weatherstripping, etc. "Temporary" measures would be things like a setback of heating thermostats, which work well until there is a prolonged spell of severe weather, when they are likely to be overridden, thus aggravating the utility peak. Both "temporary" and "permanent" measures can save the customer money – but only "permanent" measures are certain to save the utility on demand.

Programs specifically designed to reduce demand (load management) are very compatible with conservation programs and often can produce substantial savings.

Some utilities may have in-house staff capable of generating load and rate impact estimates for a Home Audit Program. As utilities gain experience administering Home Audit Programs, better data may be generated.

The Office of Technology Assessment (OTA), an advisory arm of the U.S. Congress, recently studied the impact of residential conservation on load factors and concluded that most utilities "will not be measurably affected" unless a third or more of the utility's customers use electric heat. A summary of the OTA findings is attached as Appendix B.

Once information has been developed on the number of homes to be served, the expected energy conservation, and the impact on utility loads/revenues, utility decision-making can proceed intelligently. The following pages summarize the preceding discussion, and provide a simple format to help a utility assemble the information necessary for decisions.

PROGRAM PLANNING WORKSHEET I

Purpose: To Help Define a Target Group of Homes to be Audited

1. Total Number of Residential Customers __________
2. Number of Electrically Heated Single Family Homes __________
3. Percentage Saturation of Electric Heat __________
4. Approximate Age of Electric Heat Homes (relative percentage)

Pre-1945 __________
1946-1955 __________
1956-1975 __________
Post 1975 __________

Note: You should establish these groups yourself, using your own knowledge of the characteristics of the homes in your community. For example, if an insulation ordinance was approved in 1972, you could set "Post-1972" as a category.

5. Estimated Levels of Insulation Within Each Group of Homes (Check attic insulation only, unless you have a *very* well weatherized community.)

Pre-1945 __________
1946-1955 __________
1956-1975 __________
Post 1975 __________

Note: This question calls for some creative research. You could talk with a local building code official. Or, you might survey all the utility employees. Be sure that you differentiate between insulation *recently installed* and amounts that were in the house, say, five years ago.

6. Any Special Considerations?

   a. Do you have easy access to the attic in all age groups of homes?

   b. Is there a special need for audit services for the elderly, infirm, or low-income groups? Do they live in identifiable neighborhoods?

At this point, you can start to make some decisions and estimate impacts.

A. Look at question #5. Are there groups of homes that have little or no attic insulation? These are prime targets. If question #4 shows that these homes also account for a large amount of your electric heat load, then you can give them top priority.

B. Look at question #3. If your saturation of electric heat customers is extremely high, you might want to restrict your audit program just to them. If, on the other hand, your saturation of electric heat customers is extremely low, you might want to offer audit services to all customers, but make a special effort to contact those with electric heat.

C. Question #6 was designed to help you focus on certain housing groups – or eliminate others. You should provide the "special considerations" for your own community.

This worksheet is based on the assumption that you want in your Home Audit Program to achieve the most savings possible in *electricity*. Given that assumption, you will want to narrow down your target population of homes. To do that, it helps to know which homes are electrically heated and which homes are inadequately insulated.

You don't need to work from the standpoint of electric savings only. If you decide, instead, that your Home Audit Program will be aimed at those customers who are finding it financially difficult to meet their winter utility bills, then you would go about finding your target population in a different manner.

PROGRAM PLANNING WORKSHEET II

Purpose: To Estimate Possible Load and Revenue Impacts of a Home Audit Program

Estimating the impact of a Home Audit Program on your system's load demand or revenues is an exercise that requires, at first, a lot of assumptions. As you implement your program, however, you will develop results which you can substitute for assumptions in order to feel more comfortable with your analysis.

Accordingly, an elementary analysis worksheet is provided here for you to experiment with, as well as a set of sample assumptions that you are free to change.

A few facts that may help you to get a handle on estimating the average savings in a retrofitted home include: The Department of Energy says that caulking and weatherstripping will save up to ten percent of the heating energy; attic insulation to R-19 where none existed before will save up to 40 percent (See Appendix A). A twenty percent average savings is probably a safe estimate. Another source might be large investor-owned or public power systems in the area. They are required, as part of the federally-mandated Residential Conservation Service, to estimate savings in a "typical" home for various energy conservation installations. That kind of information can help you greatly.

Sample Assumptions:

Your Home Energy Audit Program is going to focus on electrically heated and/or cooled residences. Further, residential electric sales make up at least ten percent of your total sales. Otherwise, if sales are lower, you can skip this worksheet, as the impact of a Home Audit Program on your revenues would be negligible.

You have one full-time person working on the Home Energy Audit Program. He/she can do three audits a day, or twelve a week, with one day set aside for paperwork and planning. This totals 624 audits completed in a year.

You have an aggressive and persuasive auditor and a full 50 percent of those audited decide to make weatherstripping improvements. Your recommendations, caulking and weatherstripping and attic insulation, will reduce heating loads on the average by twenty-five percent (this is a conservative estimate).

To find the average heating load, you take an average winter month's bill and subtract from it a typical spring month's bill. The difference is the amount of electricity used to heat.

SAMPLE CALCULATION

1. Percentage Saturation of Electric Homes ________
2. Number of Electric Homes Audited in a Year ________
3. Average Yearly Heating Load for an Electric Home ________
4. Amount of Saving in a Typical Home Through Retrofit Program – Percentage or kwh* ________
5. Number of Audited Homes Making Conservation Improvements ________
6. Total Kwh Saved in Audited Homes That Have Been Retrofitted (kwh from #4 and #5) ________
7. Revenues Foregone as a Result of the Home Audit Program ________

You must bear in the mind that, while an effective conservation program might result in a short-term loss, the long-term picture is a savings in capacity that can be deferred.

*You might want to keep detailed records on the consumption before and after audit of those audited during the first year.

Identifying Available Resources

Once the program goals have been established, the utility must identify the resources available to meet those goals. There is generally a wide variety of resources which can be used by the utility. However, use of these resources requires planning and a good deal of skill in getting a variety of people and groups to work together.

Utility Staff

Are there utility staff people available to work on a Home Audit Program? How much time are they able to devote to Home Audit Program activities? What are their skills and abilities? Remember in assessing skills and capabilities those not included in the job descriptions for the position in which the utility staff person currently works. Amateur photography, construction hobbies, and other non-job activities may be very useful in a Home Audit Program.

Utility Budget

When the idea of a Home Audit Program is first broached, it is unlikely that managers, boards, etc. will have a clear idea as to costs. A full presentation of the proposed project, complete with an estimated first year budget, should assist in winning approval of the program. Sample budgets are included as Appendix D. Nonetheless, a utility should try to establish how much money is or will be available to finance the Home Audit Program. Any restrictions on the expenditure of budget funds should be noted. For instance, an amount of money might be available for personnel, but not for materials or advertising. Budget allocations must be noted from the beginning. A utility will have to decide whether the necessary funds will come from rates, charges to homeowners, or a combination of the two.

Other Municipal Staff/Budget

Utilities which are operated by a staff which is part of the municipal government may be able to use either staff or budget from related municipal agencies or activities. For example, staff from the housing or public works departments might be available, part-time, to assist in the work of a Home Audit Program. Many municipalities, however, have strict limitations on the transfer of budget or personnel. Check your local ordinances before assuming that such transfers are possible.

Community Resources

Besides the resources of the utility and/or the municipality, most communities have other resources, staff and funds, which might be used by a Home Audit Program. Examples of such resources are as follows.

- School Staff

Local school teachers and maintenance personnel may have skills which could be utilized in a Home Audit Program. Often these people are interested if their help is requested and they are given specific tasks.

- College Staff

College teaching and maintenance staff may be available on an advisory basis. These individuals offer the utility volunteer technical expertise that the utility could not afford to hire.

- Students

Local high school and college students often can make a significant contribution to a Home Audit Program. Publicity, clerical assistance, audit staff, and fix-up workers (caulking/weatherstripping) can be provided by part-time student help. APPA member utilities have had good experience working with students.

Interns from college community action programs can help to organize and run special events like energy fairs.

- Banks and Contractors

Banks and contractors are often willing to lend assistance to a Home Audit Program since both stand to gain directly from Home Audit Program activities. Publicity and financing may be requested of these businesses. In some programs, they have actually contributed start-up or operations funding.

- Government Extension Services

Every county has an agricultural agent, and soon every state will have a federally-funded Energy Extension Service which will, to some extent, parallel the Agricultural Extension Service. Both programs have staff and materials available to promote energy conservation. These should be integrated with the utility Home Audit Program.

- Citizen Advisors

Many communities have citizens groups of various kinds – social, consumer, environmental, business associations, etc. – which have as their purpose contributing to public causes. These groups can be a good source of volunteer labor and fund-raising activities.

The nucleus of an ongoing Citizen Advisory Committee should be identified and contacted during this initial planning activity. Likely candidates for the committee would include: the mayor or city counselors, builders, bankers, energy conservation contractors, architects, engineers, and school board members. The inclusion of a group of influential citizens in the planning of the Home Audit Program will ensure their later support for the program and may take some of the planning burden off the shoulders of utility staff.

HOME AUDIT PROGRAM PLANNING WORKSHEET

Defining Resources

1. Staff

   a. *Utility Personnel*

Department	Name	Skills	Hours/Week

   b. *Municipal Personnel*

Department	Name	Skills	Hours/Week

   c. *Other Personnel*

Department	Name	Skills	Hours/Week

2. **Budget**

a. *Available funds – local*

Utility

Personnel

General and
Administrative

Public
Communication

b. *Available funds – other*

State

Personnel

General and
Administrative

Other

c. *Fundraising Possibilities*

Source	Activity	Dollar Potential

II. ASSESSING THE CAPABILITIES OF CONTRACTORS AND BANKS

The second major planning activity is not nearly as complex as the first. It involves determining the capability of local contractors, potential problem areas with installations, and available loans and government grants to help people finance conservation investments. Much of the basic work for this activity will be done by the state government, which must, by law, produce master records of approved installation contractors and banks. Utilities should keep in touch with the state agency in charge of assembling the master records, while doing a bit of local legwork, as follows.

Contractors and Materials Suppliers

Determining the capabilities of local contractors and suppliers, and defining the areas of potential installation problems, involves personal contact with the contractors and suppliers. The utility should visit each contractor to inform them of the purpose and activities of the Home Audit Program. Copies of recommended installation guidelines and regulations available from state agencies should be distributed. (Appendix J is a sample of the kind of booklet available from state energy offices.) The contractor should be convinced that the Home Audit Program will be good for business, because it will produce more customers. Finally, the utility should gather some specific information, outlined below.

The contractors should expect regular contacts from the utility during the course of the Home Audit Program, to help them meet the needs of homeowners. Feedback and suggestions for the program's operations should be solicited from contractors during the initial and all subsequent visits.

Repairs Performed

First, the utility should determine what repair or retrofit services local contractors provide and what repairs they don't make. Some of the measures recommended by the Department of Energy may not be available locally. These service gaps should be identified. Availability of do-it-yourself materials must also be identified.

Capacity

The second step is to determine how much work the local contractors can handle, and what is the available supply of do-it-yourself materials. There is no point in having the Home Audit Program generate a large demand for conservation improvements which cannot be satisfied.

Materials/Workmanship Standards

The third step is to determine if locally available materials and/or contractor installations meet applicable federal and state standards. During the next few years, energy conservation will be a popular topic for government agency "consumer protection" publicity. A utility which, out of ignorance, appears to be recommending installations and materials which do not meet government standards will look very foolish. Refer to Appendix J for a sample Department of Energy standard for loose-fill insulation.

Material and installation standards for other conservation measures may be obtained from your state energy office or from DOE, 1000 Independence Avenue, Southwest, Room GH068, Washington, D.C. 20585.

Training/Education Needs

The fourth step is to summarize the assessments of the contractors and suppliers to determine the need for training and/or education. It is not necessary that the utility provide training; in most cases utilities will not have the necessary technical expertise. However, utilities can act to coordinate training, by matching a local community college instructor with contractors, or arranging to have the local high school teach caulking and weatherstripping in shop class.

Banks and Other Funding Sources

The second outside problem that utilities face is the availability of money homeowners need to make energy conservation improvements. These improvements average as much as $2,000 per house. Few homeowners have that much cash readily available, so they must finance improvements with loans or grants. Utilities can be helpful to homeowners by steering them towards financing. Two main sources of money are available:

Bank Loans

Banks, savings and loan institutions, and credit unions are generally willing to lend credit-worthy homeowners money to make energy conservation improvements. In some areas, however, money is tight and home improvement loans are not available or have restrictions of one kind or another. A utility should determine what lenders and what loan funds are available in its area. Since lending conditions vary considerably from year to year, this information-gathering process will have to be repeated on a periodic basis. A form that may be used in surveying lending institutions is included as Appendix F.

Federal Grants

Homeowners who cannot obtain or afford commercial loans for energy conservation improvements may be able to get money through various federal programs. Examples of these programs are as follows:

- Low-income Weatherization (CSA, DOE)

  The federal government is operating a program to provide materials for the weatherization of low-income homes. Originally the program was operated by the Community Services Administration. In 1978, the program was transferred to the Department of Energy, which resulted in changes in local administration in many areas.

Weatherization funding is principally for materials, though some money is available for supervisory labor and administration functions. Typically, local program administrators will combine materials funding from the weatherization program with funds for labor coming from CETA (Comprehensive Employment Training Act) to provide services to low income families. Weatherization grants are a maximum of $800 in most areas.

Further information on the federal low-income Weatherization program and a list of local contact offices are included as Appendix H.

- Community Development Grants (HUD)

  Many communities have received large Community Development Block Grants from the Department of Housing and Urban Development. These grants are for a variety of purposes, as designated by the local community. Among the permissible Community Development Block Grant activities are the subsidization of energy conservation or weatherization installations for homeowners. In recent years, the use of Block Grant funds has been restricted to low-income people, and in most communities the funds are used only in designated Block Grant neighborhoods.

- Farmers' Home Loans (FmHA)

  In rural areas, the Farmers' Home Administration is offering relatively low-cost financing for energy conservation improvements for houses. The Administration has adopted a detailed set of standards for energy conservation installations it finances. However, money is available at attractive rates.

- 312 Low-Interest Loans (HUD)

  The Department of Housing and Urban Development offers a program of low-interest (3%) loans for home improvements, including energy conservation improvements. The availability of the loans is restricted to certain neighborhoods in certain communities. Also, procedures for a 312 loan application are usually very complex, so that the program has not been widely used.

Some public power systems provide their customers at the time of the audit with a fact sheet listing the various local lending institutions (with names and telephone numbers), noting any low-interest conservation programs. Federal or state grant and subsidized loan programs are also included, along with a brief description of who is eligible. In addition, tax credit information for installation of solar and conservation measures is described.

Information on the Financing Fact Sheet should be re-checked and updated periodically.

The utility should check with government agencies in its area to determine available funding, eligibility criteria, and application procedures. A worksheet summarizing this planning activity follows as the next page.

HOME AUDIT PROGRAM PLANNING WORKSHEET

Assessing Capabilities of Contractors and Banks

1. Installations/Materials Available (Jobs/Month)

ITEM	CONTRACTORS	DO-IT-YOURSELF MATERIALS	MEET STANDARDS	TRAINING NEEDED
Insulation				
Attic				
Wall				
Pipe/Duct				
Floors				
Storm W/D				
Caulking				
Weatherstrip				
Furnace Work				

TOTALS:

2. Funding Sources

SOURCE	AMOUNT	TERMS/ QUALIFICATIONS	APPLICATION PROCEDURE
Banks			
______			
______			
______			
______			
Government Agencies			
______			
______			
______			
______			
______			

III. DEVELOPING THE ENERGY AUDIT

The energy audit is a process designed to tell a homeowner what energy conservation improvements cost and how much they can be expected to save. A large variety of energy audit systems are available. They range from a complex DOE-sponsored analysis operated in New Jersey by a team from Princeton University (at a cost of $30,000 per house) to a simple manual checklist which is completed by the homeowner. The energy audit procedure discussed below is recommended for small utilities.

Suggested Format-Overview

The small utility energy audit system includes four parts:

- Home Energy Analysis Checklist
- Utility Recommendations
- Consumer Information Sheets
- Lenders and Contractors

The system is designed to operate out of the briefcase of the small utility energy auditor. Using the system, an energy audit can be delivered to a homeowner in a single visit to the house. Auditors in larger utility programs should be provided with daily itineraries and activity logs.

Home Energy Analysis Checklist

The Home Energy Analysis Checklist is a single sheet form, used by the energy auditor in his/her inspection of a customer's home. The checklist enables the auditor to easily note the areas of energy use in the house which require improvement. The design of the audit checklist will determine, to a large extent, the complexity and length of the audit. Full heat/loss calculations will add time to the audit. One smaller utility presents homeowners with a list of recommended measures and ranges of savings for a "typical" home. If the customer is interested in more specific technical information, the utility auditor will compute heat loss/gain and specific savings for the home.

Other decisions about the audit checklist involve measures that you might wish to add to the list. Utilities in California check swimming pools and recommend pool covers. Those in the Southwest often suggest window treatments to control solar infiltration. A utility with a load management program might use the audit to educate residents about the program and sign them up.

Finally, a utility planner must decide whether cost/savings information will be expressed in dollars, percentage of fuel costs, or both. Public power systems with low residential rates might find that paybacks expressed in dollars are too discouraging to homeowners. Public power systems in the Northwest have started to use cost of future generation, rather than current costs, in determining the cost-effectiveness of recommended conservation measures.

Sample checklists and audit forms used in other utility programs are located in Appendix E. The form should be printed on multipart paper to allow one copy for the homeowner and one copy for utility files.

To complete this checklist properly, an auditor will need a small set of tools including:

TOOL	COST
16′ Tape Measure	$ 12.00
Walking Tape Measure	26.00
Flashlight	5.00
Clipboard	5.00
Cordless Electric Drill	20.00
Pipe Calipers	1.50
Furnace Test Kit (optional)	120.00
	$189.50

Utility Recommendations

Once the auditor completes the home inspection, he/she makes up an informational package for the homeowner. The informational package, or Homeowner Kit, consists of the checklist, recommendations to the homeowner on suggested improvements, and do-it-yourself information sheets.

Recommendations made by the auditor may be included on the checklist or may be listed on a separate sheet. These suggestions should always be in writing and should be listed in terms of cost-effectiveness. A copy should be left with the homeowner and another copy retained in the utility's file. A sample recommendation sheet follows on the next page.

Auditors should carefully explain each recommendation and advise homeowners whether contractors are needed. All questions of the homeowner should be answered even if this takes extra time.

Consumer Information Sheets

In addition to specific recommendations for conservation improvements, the auditor places in the Homeowner Kit basic consumer information sheets relating to each recommended improvement.

The consumer information sheets repeat basic information about the energy-saving measure, refer the homeowner to a material ordering procedure, and tell the homeowner, step-by-step, how to make the recommended installation.

A sample set of consumer information sheets is included as Appendix K.

OUR RECOMMENDATIONS AND WHAT THEY WILL COST YOU

We Recommend That You:	What It Will Cost You:	
	If You Install:	If Contractor Installs:
1.		
2.		
3.		
4.		
5.		
TOTAL COST	$	$

HOW MUCH YOU CAN EXPECT TO SAVE

Recommendation	Estimated Yearly Savings	Payback Period*
1.		
2.		
3.		
4.		
5.		
TOTAL Yearly Savings	$	

Your Combined State and Federal Tax Savings	$

* The Payback Period is how long it will take you to get your energy conservation investment back. It is based on the contractor-installed cost, and the assumption that energy prices will rise at an annual rate of 10 percent, and that you pay an interest rate of 18 percent on the money used for the energy home improvements.

Extra copies of the consumer information sheets may be carried in an accordian file. The auditor can then look at his recommendation list and pull the appropriate information sheets from the file to give to the homeowner.

Lenders and Contractors

The Master Records of approved lenders and contractors, as assembled by the responsible state agency, should be included in each Homeowner Kit. A sample list, developed by the municipal utility of Palo Alto, California, is included as Appendix G.

Oil and Gas Heated Homes

Though the utility's principal concentration will be electrically heated homes, it may be advantageous, or necessary as a public service, for the utility to offer energy audits to customers whose homes are heated with oil or gas. In these cases, a troublesome question often arises about testing and recommending modifications to oil and gas furnaces and boilers.

The utility may wish to arrange with local gas and oil suppliers to shift to them all or part of the audit responsibility for their heating fuel customers. A referral system may be arranged with these dealers.

The utility can, however, at least supply oil and gas heated homes with boiler/furnace efficiency information. A good pamphlet is available from the Department of Energy.

Availability of Materials

The various materials described above – checklist, utility recommendations, and consumer information sheets – can be developed by each utility, using material from the appendices to this manual. (See Appendices E and K.) In addition, supplementary information is available from the federal government, state and local governments, and universities. The various kinds of materials and their sources are described below.

Federal Government DOE and HUD Materials

In addition to the materials necessary for the operation of the suggested format energy audit program, many more publications, movies, and filmstrips are available from the federal government. For a title list, write Energy, P.O. Box 62, Oak Ridge, TN 37830.

State and Local Government Materials

In addition to the materials available from the federal government, many state and local governments have commissioned energy conservation studies or have purchased some of the federal materials for use in the state or locality. Check with the responsible official in your state energy office, or its equivalent, for information about locally available materials. A list of state energy office officials is included as Appendix L.

There are also more than 2,500 libraries in the country. Many local libraries maintain a collection of publications and filmstrips that will be of use in an energy conservation program. In addition to materials actually purchased by the local library, many libraries participate in lending programs which give them access to resources in other cities around the state.

University Materials

Many universities have done research on energy conservation during the past few years. Their reports and/or publications should be available to a utility operating an energy conservation program. Also, university librarians maintain good collections of federal and other energy conservation publications. Depending on the policy of the university, it may be possible for a utility to borrow or copy books or pamphlets.

Agricultural Extension Service Materials

The federal Agricultural Extension Service has developed a set of materials on home energy conservation for use by its local extension agents. Though the agents may be unwilling to loan their slide shows and other materials, they are generally willing to present the slide show to public audiences. This arrangement should be utilized by utilities which are looking for ways to supplement existing manpower. Contact your local extension agent for more information.

Another possible source of materials and technical advice is the state Energy Extension Service. Energy Extension Services have been established in most states. A directory list is part of Appendix L.

Other Utilities

Most utilities have developed a good variety of consumer publications on energy conservation and are generous about allowing another utility to duplicate their material. Cooperation between utilities in the same service area is especially useful because it reduces the chances of confusing customers with differing information. Small public power systems in a joint action agency might request the agency to develop conservation materials that could be used by all participants.

Useful technical and consumer-oriented conservation material can often be picked up at trade association shows or utility workshops. APPA's annual Energy Management Workshop, for instance, features an "Idea Exchange" where brochures, audit forms, etc., are traded.

Test Program-Utility Employees

Before offering the energy audit service to all residential customers, it is usually a good idea for the utility to test the program on a friendly group, such as its employees. This test gives the utility auditor a bit of experience in the field, looking at houses and dealing with homeowners. Field experience gives the auditor some confidence in his/her abilities and the value of the program. The response of the utility employees to the program format and materials will disclose any obvious shortcomings or problems with the program before it reaches the general public.

IV. PUBLIC COMMUNICATIONS

One of the keys to the success of a Home Audit Program is public communications. Public communications means a systematic effort on the part of the utility to make the Home Audit Program understandable and attractive to the general public. The following discussion will show a small utility how to organize an effective public communications program, which makes maximum use of local non-utility resources. Remember that the key to any public communications or advertising program is multiple impressions – the same message repeated to the homeowner in a number of different ways from a number of different sources.

As general background on the subject, refer to Chapter VI of the APPA revised Public Relations Manual, which deals specifically with energy conservation programs.

Identify Resources

The first task that a utility must undertake in its effort to educate and interest the general public is to identify the available resources, and the exact information each resource can communicate.

Newspapers

The first resource available to most utilities is the local newspaper, which will generally be delighted to run articles on the utility energy conservation program. Newspaper articles can be classified in three categories. A utility should work with local editors on articles in all three categories.

- Straight News

  The day the program is announced the utility should hold a press conference to kick off the effort. As the program progresses, other news opportunities should be exploited to bring the program to the attention of the readers. Examples of news opportunities are the one hundredth local house to be audited or a local response to a Presidential speech or conservation program announcement. It is always good to provide the newspaper with either a photo opportunity or a glossy print to accompany the article. Every news event should be announced by a press release, which need only be a simple statement of the facts – nothing elaborate. A press release usually saves a lot of trouble, by making sure names are spelled correctly, and figures are copied down accurately.

- Background

Background, or human interest stories try to fill out the news with human dimensions, and put news events into perspective. Most newspapers are looking for good background stories. Some of these stories are developed by investigating reporters, but most are the result of a good public communications effort which presents story opportunities to reporters and then helps the reporter with research. Like most other people, reporters are grateful for a little help on the job.

- How-To-Stories

The third kind of newspaper article that is useful to a utility Home Audit Program is a how-to-article. The most effective format for these is a series, which runs through a number of different energy conservation techniques or installations in detail. The series, of course, can be simple adaptations of the materials designed for distribution in the Homeowner Kits. Another good format is question-and-answer, in which the utility auditor answers practical questions posed by homeowners.

Radio Stations

Local radio stations are another public communications resource available to utility Home Audit Programs. The three basic types of coverage offered by newspapers – news, background, and how-to-articles – are basically duplicated by radio stations. Perhaps the best radio program opportunity for publicizing the utility Home Audit Program is the talk show or call-in show, where the guest fields questions from the radio audience.

Citizen Groups

A third source of beneficial public communications for utility Home Audit Programs is the various citizen groups in the local area. It is especially effective for the energy audit program to be endorsed by a credible third party – a citizens group which has established credibility with homeowners on some basis besides energy conservation. A citizens group, whether it is a fraternal organization, church society, consumer or environmental group, or business club, can help the utility communicate the basic conservation message to homeowners. Using the communication facilities of the organization, whether it be newsletters or meetings, the utility can publicize its program effectively and inexpensively.

Schools and Libraries

Other ready sources of public relations for the utility Home Audit Program are the local schools and libraries. The first thing to do is to place display ads – posters, brochures – in lobbies and have the students take homeowner sign-up forms to their parents. A second approach is to have the school or library sponsor public meetings at which the utility presents its energy audit program. If possible, a series of meetings can be held – the first to introduce the program, subsequent meetings to teach homeowners in detail the value of major improvements and the techniques for making the improvements.

Other

Promotion of a utility home energy audit program need not be limited to traditional media. Door hangers, thermograms, outdoor billboard messages, display booths at malls and county fairs, and posters in city buses can all be helpful in reaching previously overlooked segments of the population.

In some communities, letters from the utility manager explaining the home energy audit program have triggered a large public demand for the service. "Bangtail" envelopes – where conservation information must be removed from the envelope before it can be sealed – are expensive, but also generate a large response to the audit offer.

Advertising and Audit Backlogs

In the interest of avoiding an "avalanche" of audit requests from the community, most public power systems use free publicity, such as releasing stories to local news media, when first announcing the audit program. Publicity from local newspaper and radio stories will provide the initial wave of public interest in the program. Thereafter, bill stuffers, paid advertising and other promotional techniques can be used when demand for audits slows.

Utilities can – and should – control the offering of the audit by judicious use of advertising, so that the audit backlog never becomes too great. Although residential customers in smaller communities can often be surprisingly patient with a long delay in receiving an audit, a wait of more than two months may discourage the customer and hurt the utility's reputation.

Because utilities will never be able to perfectly control the number of people requesting audits (a month of chilling temperatures and high heating bills or a local front-page newspaper story on the program may throw off schedule even the best-planned program), it would be desirable to have other utility personnel trained and prepared to assist with the program on a temporary basis. This builds flexibility into the program, and provides a sometimes-welcome change of pace to non-auditor employees.

Appoint Citizen Advisory Committee

In trying to organize an effective and economical public communications campaign for its Home Audit Program, a small utility will benefit from the formation of a strong, active Citizen Advisory Committee. This Committee can help the utility publicize the energy audit program, and take on much of the actual work burden which would otherwise fall on utility employees. In addition, a Committee will often attract members with useful professional skills which the utility could not afford to hire.

Organizing an effective Citizen Advisory Committee is a two-step process – recruiting broad spectrum representation in the membership, and establishing a reasonable public communications program and schedule for the Committee to perform.

Broad Spectrum Representation

It is essential that an effective Citizen Advisory Committee represent all of the important segments of the community, but especially those that are in constant communication with the public, such as:

- Newspapers
- Radio Stations
- Citizens Groups
- Schools and Libraries

In addition to representatives of these organizations, it is usually helpful to have one or more city officials as members, plus representatives of any minority groups in the area. Be careful not to recruit too many members or members who are really not interested in working. You will have a problem, rather than an asset, if your committee is a twenty-member debating society. Six to ten members is probably the ideal number.

Reasonable Program and Schedule

Once the committee members have been selected, the utility should present them with a program plan and schedule for the public communications program. In designing the plan, utility staff should keep in mind that what they want is a program which toes a fine line. On the one hand, the utility should not sit down with the committee with no preconceived program plan. Committee members are willing to donate some time, but nothing discourages volunteers faster than the notion that their leaders do not know what they are doing. On the other hand, the utility should not treat the Committee members like unpaid employees. A balance of utility direction and Committee feedback will achieve the best results.

V. PROGRAM PLAN

The final stage in the *planning* process for a small utility energy audit program is writing a program plan and getting it approved by the governing authority of the utility – the board or the city council. The Program Plan is based on the information gathered during the other *planning* activities:

- Defining Utility Goals and Resources
- Assessing Contractor and Bank Capabilities
- Developing the Energy Audit
- Developing a Public Relations Campaign

Program Plan Contents

The Program Plan is a summary of what was learned during the planning process. It should be short, simple, and to the point. The following discussion outlines a basic Program

Plan, suitable for presentation to the utility governing board. The plan consists of five elements:

- Activities
- Impact
- Staffing
- Schedule
- Budget

Activities

The first section of the plan should explain what the utility proposes to do in its Home Audit Program. The following questions should be announced:

- How many homes will be audited?
- What will the audit consist of?
- What forms and procedures will be used? Samples should be attached to the plan when submitted.

The description of the program activities should only require a few pages. Remember that the officials who are reading the plan are unfamiliar with Home Audit Program activities. The description must be clear and logical.

Impact

The second section of the plan should briefly discuss the expected impact of the Home Audit Program. This should not be a "sales pitch" for how good the program is, but an objective discussion of the probable results of the program. Questions to be addressed include:

- What are the potential gross energy savings for the program?
- Can the gross savings be pinpointed to any group of customers, or fuel type?
- What negative impacts will there be for the utility, in terms of load and revenue?

The writer of the plan should be prepared to answer hard questions on the potential impact of the Home Audit Program. Utility board members are justifiably concerned about the financial health of the utility and will want to be sure that the Home Audit Program is founded on solid analysis and planning.

Staffing

The third major area to be addressed in the Program Plan is staffing. The plan must explain who is going to do what tasks in the Home Audit Program. The description of program staffing should include both full and part-time utility staff plus volunteer staff like the Citizen Advisory Committee. The staffing section of the plan should also include a table of organization, a simple graphic representation of program staffing. (Refer to Greenville, N.C. case history in Appendix M.) Short résumés of proposed staff not known to the board should also be included, so that the board feels comfortable with the qualifications of the staffers.

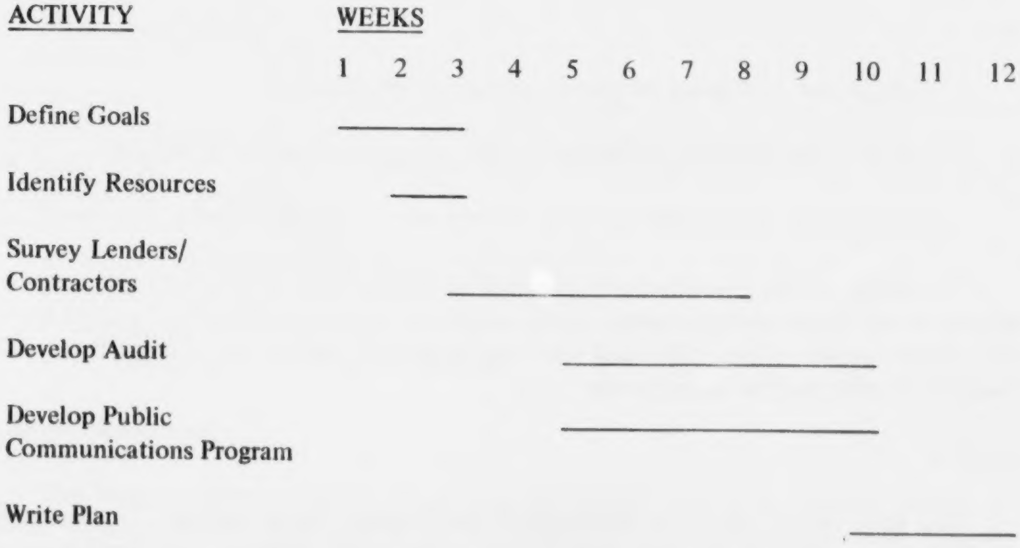
Schedule

The fourth element of the Program Plan is a schedule of program activities. Be conservative in laying out this schedule. Things always take longer than when first planned. Make sure your written schedule in the plan is easily achievable. You will look much better to the board if you are a couple of weeks ahead, rather than a couple of weeks behind, your projected schedule.

Budget

The final element in the Home Audit Program Plan is a budget of the estimated costs of the program. The proper form for this budget presentation will vary from utility to utility: make sure to match the form of your presentation to the normal budget format of the utility. Some utility boards will require considerable detail in budgeting – precise cost estimates for program elements, cash flow projections, and other back-up materials. Some utility boards do not require, and do not want, such detailed presentations. A simple summary of the costs in a few categories is sufficient in these cases.

The chart below graphically summarizes the program planning process, assuming that the utility assigns one person, full-time, to program planning.



Program Plan Approval

Writing a good energy audit Program Plan is only half the battle, often the easiest half. The second task is to convince the utility governing board to accept and support the plan. In approaching this task it is important to use the information and the contacts developed during the *planning* process to make the strongest case before the board.

The five main points to be made in support of the Home Audit Program are:

- The economic benefits for homeowners and the community in general.
- The necessity of this service for homeowners.
- The importance of energy conservation for the nation and the economy.
- Savings through the deferment of additional investment in generating capacity or purchasing power.
- Stimulation of the local economy through increased sales of energy-conserving installations.

These five points are discussed below, with suggestions as to how the planning information can be integrated into an effective presentation.

Benefits to Homeowners/Community

The first point to make is that the Home Audit Program will provide significant economic benefits to the individual homeowner and the community. In order to document this, use information developed in the *Planning* process:

- Typical house – needs and potential savings.
- Total community – needs and potential savings.

You may want to take a specific example of a homeowner who needs the Home Audit services. Talk about the homeowner's fuel bills, the condition of his/her house, and the savings that could be effected in the program. Then extend that example to the entire community, using the gross estimate numbers developed on the worksheet (section A-1 above). Paint the most accurate picture that you can of the benefits that will flow from the program.

Necessary Service

The second point in the effort to inform the governing board of the need for a Home Audit Program Plan is that the program is a necessary service for the community. The facts from the planning research that should be used to make this point are:

- The lack of energy audit services or useful energy conservation information (materials and installation instructions, cost/benefit analyses) from sources other than the utility.

- The need to coordinate the resources of local banks, contractors, and government agencies to help homeowners save energy and money.

- Widespread community support for a utility energy audit program, demonstrated by a list of people who have agreed to serve on the Citizen Advisory Committee.

Again, focus on a specific example of how the Home Audit Program will aid the utility or local government. Perhaps there is a locally sensitive issue on which a number of people or groups have opposed the utility – rate increases, for example. Show the board how the Home Audit Program gives these angry people a reason to support the utility again. Stress the human element of the program. It is not a computer in Washington spitting numbers at homeowners. It is a local utility staffer going into people's homes to help families solve a very worrisome problem.

Energy Conservation – Nation and Economy

A third point to make is that energy conservation is important for the strength of the nation and the health of the economy. Energy conservation is the centerpiece of current national energy and economic policy. The utility is in a unique position in the community to help homeowners not only understand the importance of conservation, but also to help them do it.

Deferment of Investments in Generating Capacity

Many utilities will be able to realize substantial savings through the Home Audit Program by deferring the need for investments in new generating capacity or additional long-term power purchase contracts. These savings will be particularly significant for utilities which have a high saturation of residential electric resistance space heating and/or air conditioning. The economic case for these savings has led a number of utilities to adopt investment programs based on residential energy conservation.

The Tennessee Valley Authority's free energy surveys and interest-free loans for attic insulation and other energy-saving measures have resulted in annual kilowatt hour savings of about 152 million. As planned, TVA's home insulation program will account for an annual energy savings of 2.7 billion kilowatt hours by 1986. It will produce a consumer benefit of $81 million a year and save about 1,100 megawatts of peak demand for the system. Further, TVA finds, the agency will meet these goals at a benefit-to-cost ratio of about four to one.

In Oregon, the investor-owned Pacific Power and Light has, in lieu of investing in new generating capacity, raised about $100 million to lend to homeowners to weatherize their homes. The utility is allowed a profitable return on this capital by the regulatory agencies, because the cost to the ratepayer is less for this investment than for an investment in new generating capacity that would produce equivalent energy supplies.

Details on the TVA, PP & L, and other utility home energy audit programs are included as part of Appendix M.

Stimulation of Local Economy

A Home Audit Program, which helps to substitute investments in energy-conserving products for increased fuel expenditures, keeps money in the local community or the region. Contractors' or installers' wages are paid to local people, who recirculate the money through local businesses. Many energy-conserving products are locally or regionally manufactured (cellulose insulation, storm windows, etc.). By promoting residential energy conservation, the utility can directly help the economy of its community.

ORGANIZATION

This section of the manual will show a small utility how to organize its energy audit program to efficiently use the available manpower and budget. The section will deal with three elements of program organization:

I. Personnel

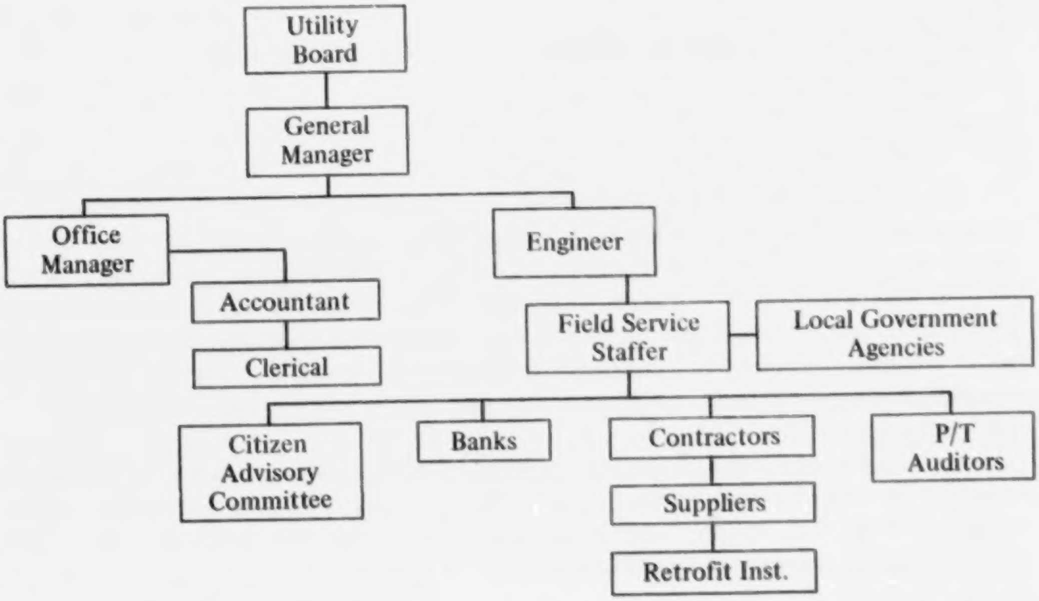
II. Systems and Procedures

III. Forms and Materials

The emphasis of this section will be on presenting small utilities with a field-tested organizational scheme which can be used as is. Most utilities, however, will make modifications in the suggested organization to fit their needs.

I. PERSONNEL

The Personnel section of the manual will outline appropriate job descriptions and training routines for utility Home Audit Program staff. The staff might look like this on an organizational chart:


Utility Board
General Manager
Office Manager
Engineer
Accountant
Clerical
Field Service Staffer
Local Government Agencies
Citizen Advisory Committee
Banks
Contractors
P/T Auditors
Suppliers
Retrofit Inst.

Full-Time Staff – Job Description

Most small utilities will be able to afford, at most, one full-time staff person for the Home Audit Program. That person will be expected to perform the following activities:

- Research and write Home Audit Program Plan, present to utility governing board, and implement with modifications as specified by the board.
- Recruit broad-spectrum Citizen Advisory Committee to aid in developing and promoting the Home Audit Program. Plan, schedule, and implement, with the assistance of the committee, an effective and inexpensive promotional campaign.
- Select appropriate home audit procedure and materials, and provide for the acquisition of the necessary materials. Select, or develop as necessary, other program materials and forms, including promotional, scheduling, budget, reporting, and record-keeping as specified by the board and the various responsible government agencies.
- Perform energy audits on customers' homes as requested, including all necessary scheduling tasks. Assemble, from previously selected materials, homeowner kits detailing recommended improvements, approximate costs, appropriate construction materials and installation standards, and estimate savings. Assist homeowners in completing energy-conserving home improvements by performing quality control inspections as necessary and resolving disputes between homeowners and contractors.
- Coordinate the work, to the extent feasible, of local banks, contractors, and government agencies with federal energy conservation grant funding, to help homeowners implement suggested energy audit improvements.

Other job descriptions for energy auditors may be found in Appendix C.

Full-Time Staff – Training

As can be seen from this job description, the position as sole full-time staff person for a small utility audit program is very demanding. Such a person should have solid training before attempting the job. The American Public Power Association is sponsoring a training program for smaller utilities designed to equip a person to begin to handle the job described above. It is recommended that the utility staff person assigned to manage a utility Home Audit Program complete this American Public Power Association training or a similar comprehensive, professionally taught training program.

At a minimum, the classroom training should cover the basics of residential construction, the properties of heat transfer, the operation of heating and cooling systems within a home and all the basic energy-saving measures, their properties, advantages/disadvantages, and how they should be installed.

After the classroom training, auditors should be given at least a week of field training. This can be done in utility employee homes, or the novice auditor can accompany an experienced auditor in the field.

Experience in installing insulation and other conservation measures can be provided by sending your auditors out with local contractors and installers. (Indirectly, this is a way to check on the work of the contractors.) Utility auditors with practical experience in installing measures will be well-prepared to answer questions from the do-it-yourself homeowner.

In addition to the field and classroom training, many utilities provide their energy auditors with special communications training, so that customer questions regarding the utility and energy issues are knowledgeably answered. And, since the final goal of a home energy audit is to motivate the homeowner to take energy-saving actions, some public power systems are recommending sales training for their auditors.

The importance of having well-trained and thoroughly experienced auditors can hardly be overemphasized. Consumers today are receiving conservation advice from numerous sources: local environmental groups, energy extension services, utilities, state energy offices, even through the newspaper. As some of the advice is conflicting, you will want your auditor to understand the reasons behind his/her recommendations.

Recently-passed legislation contains funds for state training of residential energy auditors. Check with your state energy office for further details. In addition, some states now require or plan to require that auditors be certified. This should be checked out at the state level.

Finally, even though the auditor will be constantly learning as he/she is on the job, allow time and money for continued training. Homes of unusual construction may present problems for auditors, or there may be some growing interest in solar retrofit in the community.

Part-Time Staff

In most small utility Home Audit Programs, part-time staff will serve in a limited number of positions, as follows:

Citizen Advisory Committee

Mainly promotional and public relations functions, including writing stories for newspapers, serving in a speakers' bureau, organizing meetings, taking photographs, etc. These people will receive no substantial training; rather, the utility will benefit from their skills.

Part-Time Auditors

If the utility has a particularly heavy demand, either seasonal or as a result of fuel price increases, it may want to hire part-time energy auditors. It is strongly recommended that these part-time auditors be people that successfully complete a professional training program equivalent to the one recommended above for full-time staff. Examples of likely prospects are construction tradespeople or professionals, and school teachers seeking week-end or summer work.

Retrofit Installers

Many utilities will find in the *planning* phase of their Home Audit Programs that insufficient contractor installation capabilities exist for some improvements which are simple to perform, such as caulking, weatherstripping, and pipe/duct insulation. Utilities already operating programs have had considerable success in training, for instance, local students to perform these installations during the summer.

Improvements made by these temporary workers should be carefully limited to *very simple* items. Temporary workers should be trained rigorously by local contractors *and* the utility staffer in charge of the program. An inspection of every job completed is recommended.

II. SYSTEMS AND PROCEDURES

This section of the manual will describe the basic systems and procedures which a small utility can use to operate its Home Audit Program. As with the other sections of the manual, this section is full of *suggestions*, which have been field-tested. They should be modified to meet the needs of the individual utility staff.

The system outlined below is simple and logical. It is designed to lead the homeowner to undertake some energy-conserving improvements on a do-it-yourself basis. For those improvements which are too complex for do-it-yourself, the audit system provides homeowners the information they need to shop intelligently among contractors and to check the work of the contractor hired to make the installations.

Audits

Delivering a home energy audit is a three-step procedure – scheduling, performing the audit, and preparing the Homeowner Kit for presentation. The procedure employed by an individual utility will vary according to the size and complexity of the program.

Two sample task flow charts, of differing complexity, are offered on the next few pages. Each chart is accompanied by a brief description of the procedure. Again, please refer to the appropriate forms in Appendix E.

A utility should figure that an audit program will consume 2½ to 3½ hours of staff time per house, as follows:

Activity	Hours
Scheduling	.15
Home Inspection	1.50 – 2.00
Processing	.50 – .75
Record Keeping	.25 – .50
TOTAL	2.40 – 3.40

Scheduling

Customer inquiries and requests for audits may be received by the utility through a variety of sources. So, it is important that the entire utility staff be informed and knowledgable about the energy audit program. Meter readers may be asked about the program. High bill complaints are logical candidates for energy audits.

Once the request comes in, the audit should be scheduled as soon as possible. Appointments can by made by zip code to minimize auditor travel time. If there is a backlog, the customer should be so informed. If appointments are made for weeks ahead, the utility should get a telephone number, so the appointment can be reconfirmed closer to the date.

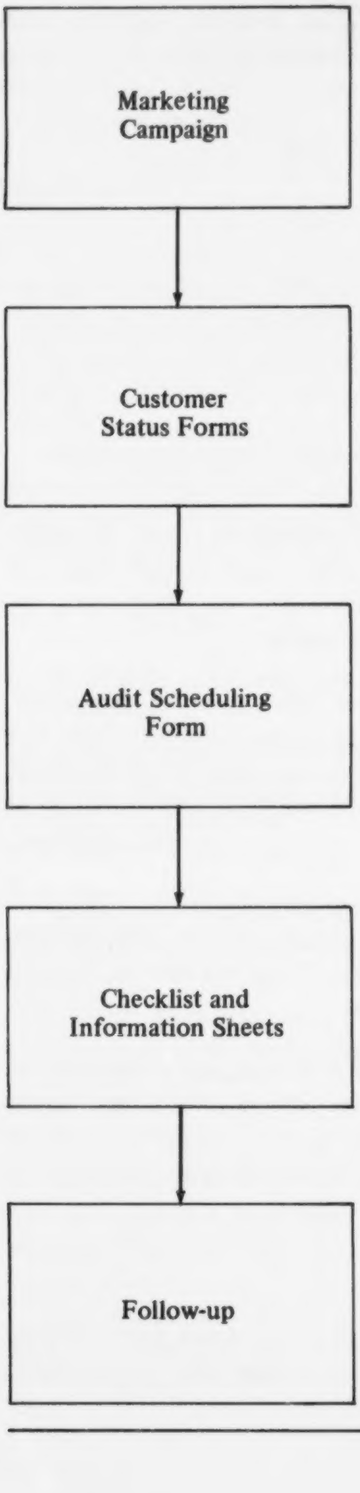
The initial telephone conversation may also be the time to gather valuable information about the home. Customers can be asked whether they have an attic, whether there is access to the attic, or whether a ladder will be available in the home. If access is through a closet, the utility can ask the customer to have the closet cleaned out.

One question that arises during planning of an energy audit program is whether you will be able to reach all interested participants, if audits are offered only during regular working hours. An auditor who can be available for work during early evening hours and on Saturdays may be required if you have a large percentage of households where homeowners are unavailable during weekdays.

Marketing/Public Communications

The basic public relations activities available to a small utility Home Audit Program were described earlier in the *planning* section. You should be familiar with these activities before reading the following discussion.

AUDIT SYSTEM 1 – SINGLE VISIT CHECKLIST


Marketing Campaign
Customer Status Forms
Audit Scheduling Form
Checklist and Information Sheets
Follow-up

The marketing campaign, conducted by the Citizen Advisory Committee, generates calls and letters to the utility.

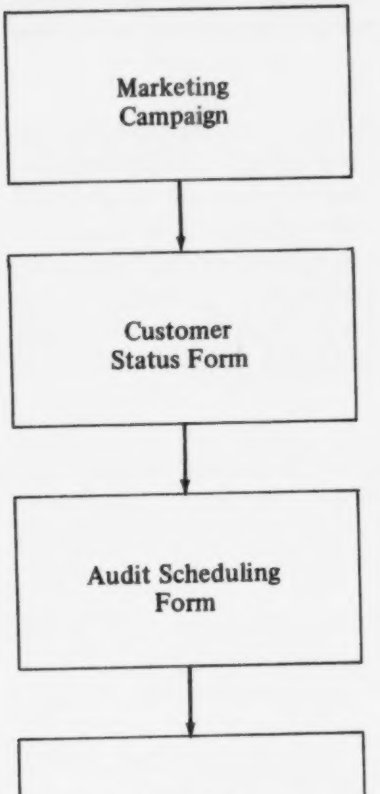
The utility completes a status sheet, with all necessary preliminary information, on each customer who requests an audit.

The utility prepares an audit schedule designed to minimize travel time between audits.

The utility auditor visits the home, completes the Home Energy Analysis Checklist and supplies the homeowner with a package of Consumer Information Sheets.

Two weeks after the audit, the utility mails the customer a follow-up letter with an invitation to call the utility if additional help is needed.

AUDIT SYSTEM 2 – SINGLE VISIT/MAIL RETURN


Marketing Campaign
Customer Status Form
Audit Scheduling Form
Field Data Gathering Form
Audit Processing
Homeowner Presentation Kit

Same as audit system 1

Same as audit system 1

Same as audit system 1

A form is used by the auditor to gather measurements and perform basic heat loss/gain calculations.

The completed Field Data Gathering Form is processed through a computer to produce a specific house cost/benefit analysis.

The computer-generated cost/benefit analysis is packaged with information sheets and mailed to the homeowners.

Scheduling

Once the local public communications opportunities have been identified, and the Citizen Advisory Committee has been established to assist the utility with public communications work, a firm schedule for marketing and public communications activities should be developed.

The schedule should be designed to provide a steady flow of audit requests from customers. If a utility has decided to target a particular group of its residential customers – by fuel type, age of house, income, etc. – the communications program must be scheduled to reach these target groups. The principal purpose of the schedule is to produce a predictable, regular work load for the auditor. Try to avoid big bulges in audit requests, which may mean that some customers will have to wait months for their audit. It is also advisable to concentrate program advertising in specific areas of neighborhoods on a rotating basis, so that requests are geographically concentrated, and can be serviced with a minimum of driving time.

A sample marketing/public communications schedule is included as the next page. The schedule employs the following resources, which will typically be available to a small utility:

- Newspaper
- Radio Station
- Utility Bill Stuffer
- Citizen Advisory Committee (six members)
- School

Using the Committee – Speakers Bureau

One very good use of the Citizen Advisory Committee, as indicated in the sample public communications schedule, is to make presentations, or speeches, to citizen groups throughout the utility service territory. The formal name for this type of activity is a Speakers Bureau, a place where groups can call to request a speaker or presentation. Most small utilities will not need a formal Speakers Bureau, but will want to place citizen committee speakers before groups.

The speeches or presentations made to citizen groups need not be elaborate. They can begin with a short slide show and proceed to discussions of specific issues, based on the home audit checklist or consumer information sheets developed for the homeowner kit. Finally, homeowners attending the presentation can be given brochures describing the audit program and its services.

Coordination With Government Agencies

From time to time during the next few years, government agencies on the federal, state, and local levels will field home energy conservation public relations campaigns. For instance, in 1979, the Department of Energy mailed a do-it-yourself information list to

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SAMPLE PUBLIC RELATIONS SCHEDULE – 12 WEEKS

WEEK 1: Utility pilot audit program begins with the auditing of employees' homes. Mail program announcements (bill stuffers) to homeowners (all or selected areas).

WEEK 2: A press conference or press release (newspaper and radio station) announces the program. Plan a media event by allowing reporters to walk through an audit of utility employees' homes. Encourage photographs.

WEEK 3: The Citizen Advisory Committee (CAC) members get their homes audited. Prepare and submit a background story for the newspaper(s) on energy audits/energy crisis.

WEEK 4: Prepare and submit a story for the radio station(s) on energy audits/energy crisis. A CAC member gives a speech to a citizens group.

WEEK 5: A second utility bill stuffer is mailed to homeowners (all or selected areas). A CAC member gives a speech to a citizens group.

WEEK 6: Energy conservation week is held at school. Plan contests for children, special classes, a fair on the weekend, or a parents' night. A CAC member gives a speech to a citizens group.

WEEK 7: Plan and construct a permanent (six week) display of home energy conservation materials at school. A CAC member gives a speech to a citizens group.

WEEK 8: Prepare and submit a how-to column in the newspaper. (1st of 5) A CAC member gives a speech to a citizens group.

WEEK 9: Prepare and submit a how-to column in the newspaper. (2nd of 5) Have a radio phone-in show discussion. A CAC member gives a speech to a citizens group. A third utility bill stuffer is mailed.

WEEK 10: Prepare and submit a how-to column in the newspaper. (3rd of 5) A CAC member gives a speech to a citizens group.

WEEK 11: Prepare and submit a how-to column in the newspaper. (4th of 5) A CAC member gives a speech to a citizens group.

WEEK 12: Prepare and submit a report to the public (press release) on the success of the program to date. Prepare and submit a how-to column in the newspaper. (5th of 5) A CAC member gives a speech to a citizens group.

every homeowner in New England. This activity generated significant interest in energy conservation in New England, and could have produced a large demand in audits for any utility in the area with an audit program.

The ongoing public relations program of the utility must take these public agency public relations programs into account. A utility should not schedule its own public relations blitz at the same time as the public agency program, or the utility will be swamped with audit requests. Also, the utility should be careful to coordinate its public relations message with what the government is saying.

Getting the Work Done

The end result of the Home Audit Program should be that homeowners make energy-conservation improvements. Accomplishment of this goal requires some follow-through on the part of the utility audit program staff. The degree of follow-through required will vary considerably from area to area, depending on the availability, skill level, and experience of local contractors. During the *planning* phase, the utility should carefully determine what gaps in installation capabilities exist in the area.

Seminars and Training

Once the needs are determined, the utility should try to construct a program to help homeowners get work done. This help will generally be in the form of training – for contractors, suppliers, and homeowners. The problem with this, of course, is that most small utilities do not have the expertise to provide the necessary training. This expertise must be created. There are some options available to utilities, as follows:

- Homeowners (Do-It-Yourself)

  The simplest training task facing utilities is training homeowners to make basic do-it-yourself installations. The list of installations for which homeowners are trained should be limited to those measures which have very little potential danger for the homeowner or the house. A basic list of these measures is:

  Caulking
  Weatherstripping
  Attic Insulation (flat, unfloored spaces)
  Pipe/Duct Insulation
  Heating System Management (including clock thermostat installation)
  Domestic Hot Water System Management

  Homeowners can generally be taught to make these basic improvements with an hour-long hands-on seminar. In order to conduct this seminar, the utility should have a supply of the consumer information sheets for each measure to be covered, and some lifesized models for homeowners to practice on. The sheets can be copied from this manual or developed by the utility. The models will usually be supplied by a local lumber yard or building materials store.

A typical seminar on caulking would consist of the following:

- Introduction to the principle behind the installation – seal the gaps in the house to prevent air infiltration (cold drafts).
- Introduction to the materials and tools to be used for the job. Start with the very basics. Everyone today nods when caulking is mentioned, but few people know what a caulking gun looks like. The different kinds of caulking should be discussed, and specific product recommendations offered, i.e. oil-based caulk dries out and cracks.
- Step-by-step installation methods. Assume your audience knows very little. Start with how to cut the tube, pierce the seal, load the gun, and lay down the bead of caulk.
- Demonstrate and let homeowners practice on the model. The model in this case would be a wall section, with a window frame, some Z-brick to simulate a foundation and an outside chimney, and siding typical of local construction. In the demonstration, homeowners would be taught how to seal the foundation sill, the window and door frames, etc. Homeowners should then be encouraged to work on the model with the sample materials to get first-hand experience with the installation before they try it on their homes.

- Temporary Retrofit Workers

In any community there are a number of homeowners, particularly elderly homeowners, who are not able to do energy conservation work themselves. Yet their homes generally require the same do-it-yourself measures (listed above) as other homes. Some utilities have been successful in training temporary retrofit workers to perform these simple do-it-yourself jobs for homeowners who cannot do the work themselves.

Generally, the temporary retrofit workers are young people, perhaps high school students working during the summer vacation or on weekends. They should be trained using the same seminar approach outlined for homeowners above, followed by some carefully supervised field experience. Always be sure that installations made by temporary retrofit workers are simple and that each job is checked.

- Suppliers

The job of working with suppliers to help homeowners get work done is the job of convincing the suppliers to stock the right products in sufficient quantities to satisfy the demand created by the audit program. Initially, most suppliers will not be very enthusiastic because the utility will seem to be telling the supplier how to run his/her business. A gradual educational approach can be taken to forming good relationships with suppliers.

Start out with a list of products that will be required. This list can be derived from the consumer information sheets (see Appendix K), or various state and federal material specifications (see Appendix J). Check the local suppliers and see which products are available and which are not. Also be on the lookout for low-quality substitute products which do not meet the proper standards.

Next, visit with the owner of the supply house and explain the energy audit program to him/her. Bring as much of the program material as possible – checklist, recommendation sheet, and consumer information sheets. Talk with the owner about the products he/she should stock and the quantity estimates. If there are unacceptable substitute products in the store, tell the owner as nicely as possible that the utility is also going to tell people which products to avoid.

An intelligent store owner should respond to this kind of reasonable presentation. After all, you are operating a program which can do nothing but increase business, if the store offers first quality products.

Hopefully, suppliers who become enthusiastic about the home audit program may actively assist a utility with advertising or by contributing materials to be used in the homeowner seminars.

- Contractors

The most difficult task for homeowners in getting work done is organizing the contractors. Generally, two contractor-related problems are encountered when a utility starts an energy audit program. The first is that some contractors do not know how to do certain kinds of installations. The second is that some contractors cut corners with materials and workmanship, and shortchange homeowners. A small utility, unfortunately, is not usually in the position to put someone in the field who is more knowledgeable and experienced than the contractors. The utility, by itself, is thus incapable of either training or quality control functions. These functions must be handled by rather roundabout procedures which are quite effective.

  - Training

  If a utility determines that local contractors are not able to perform certain energy conservation installations, it should try to get the contractors trained. During the next few years, there will be ample opportunity for contractors to receive the necessary training.

  State governments, universities, manufacturers, contractors' associations, and major utilities will all be sponsoring training programs. Utilities should encourage local contractors to participate in these programs.

- Poor Quality Work

Homeowners are very conservative, and, in the aggregate, very rational about investing money in their homes. For most people, the house is the biggest investment in their lives. The utility can minimize the problems homeowners will have with the quality of materials and workmanship by providing homeowners with ample information and a reasonable complaint resolution procedure.

A contractor who habitually cuts corners always fears a homeowner who knows what first quality work should look like. In many cases, it isn't even necessary for the homeowner to thoroughly understand all the intricacies of installation techniques, but just to be able to ask a few of the right questions. To help their customers, some public power systems provide a brochure, bill stuffer, or fact sheet giving tips on choosing an insulation contractor and ways to check that the job is done right. The consumer information sheets in Appendix K can be used as a guide for contractor materials and workmanship.

For installations which are not covered by the do-it-yourself sheets, such as wall insulation or furnace/boiler improvements, the utility should provide the homeowner with a work specification. Standard specifications for installations are published by the federal Department of Energy. A sample installation specification for loose-fill insulation is attached as Appendix J. Every homeowner who wants to have contractor installations in his/her home should be provided with a copy of the appropriate material and installation specifications by the utility.

Contractors providing installations should also be given a set of specifications. Distribution of these specifications will help homeowners protect themselves from bad contractors and will simplify the process of complaint resolution outlined below.

Quality Control

The quality control function performed by the utility audit program is designed to help homeowners who have a problem with a contractor. Most small utilities operate in communities where serious problems between a contractor and homeowner will be resolved. Otherwise, the contractor's reputation will be seriously damaged. Nonetheless, the utility should have some procedure available in case a problem arises. The following procedure involves inspections and a complaint resolution procedure.

- Inspections

The first type of inspection will help homeowners solve peculiar installation problems. Many homes, particularly older homes, contain hidden problems which appear only when an installation contractor begins work. A typical example is damaged roof timbers disclosed when the contractor cuts an access hatch into a previously inaccessible attic. The homeowner or contractor could, in this case, consult with the utility auditor to determine whether it was advisable to proceed with the contracted work or to obtain additional repair services.

The second type of inspection service is a "final" inspection to determine if the contracted work has been completed according to the program specifications. If the work in a home has been done properly, the utility auditor will supply both the homeowner and the contractor a certificate to that effect. If the work has not been done correctly, the utility auditor will supply both the homeowner and contractor a "punch list" of items to be corrected. After a specified "cure" period, if the contractors have not made satisfactory repairs (reinspected and certified by the utility auditor), the homeowner may proceed to the *Complaint Resolution Procedure* outlined below.

Many utilities have initiated successful home certification procedures, which award energy efficiency certificates to homes which are brought up to a standard. This certification could be the end result of a satisfactory utility inspection of completed work.

- Complaint Resolution

If there is a problem with a job which cannot be resolved by the inspections discussed above and some jawboning by the utility auditor, an arbitration procedure should be employed.

If the homeowner refuses to accept the determination of the auditor that the work is satisfactory, or the contractor refuses to accept the determination that the work is deficient, either party may bring the case before an arbitration panel composed of three members – a representative of the contractors, a representative of the area consumers, and a representative of the utility. The arbitration panel will review the case, making an on-site inspection if necessary, and make a determination. Again, both homeowner and contractor will receive identical written reports of the determination, and will be asked to accept the determination in writing. If either party is not satisfied, the case may then be taken to court.

Smaller utilities, for whom this arbitration procedure is onerous, might want to assemble and distribute as part of the audit homeowner kit, a list of consumer protection agencies, the Better Business Bureau, etc., as a reference for homeowners.

Financing

Another element in the service package utilities offer to help homeowners get work done is helping homeowners finance the work. The job of financing consists of two parts – locating necessary funding and helping homeowners understand the economics of energy conservation investments.

An excellent analysis of retrofit economics has been prepared by the Center for Energy Studies, University of Texas. It is included as part of Appendix A.

- Locating the Funding

During the *planning* phase of the audit program, the utility surveyed local lending institutions and government agencies to determine the availability of funding and the application procedures. This survey of lending institutions (Appendix F) should be updated periodically.

When the program is operating, financing will generally be arranged by giving the homeowner a referral to a designated bank officer or government agency staff member. The utility should be very careful to inform homeowners of the qualifications for loans or government grants, to avoid misunderstandings with the homeowner and disillusionment by the lending institutions with the utility program.

- Presenting the Economics

In many cases, the main contribution that a utility can make to helping a homeowner finance energy conservation improvements is to help the homeowner understand the true economics of the energy conservation investment.

When a homeowner invests in insulation or some other improvement which cuts energy expenditures, the savings are a return on the investment in energy conservation. This return is comparable to other returns a homeowner can realize from alternative investments, such as saving accounts. The difference between an energy conservation return on investment and savings account interest, of course, is that the savings account interest is taxable. The energy savings is not.

A good way to present the economics of conservation investments is by using the work sheet which follows:

All of the calculations involved in this worksheet are simple. The only trick is to get a reasonable savings estimate. Don't make the mistake of simply totaling individual savings estimates. If a homeowner makes a number of investments, the total savings must be calculated with a complex formula. This formula can be approximated by reducing the total fuel bill, and thus the base for a particular savings estimate, by the savings estimated for each measure, as follows:

Fuel Bill:	$1000	1200 gallons
Measures:	Attic Insulation Wall Insulation	25% savings 15% savings
Calculation:	First measure (Attic Insulation) saves 25% – $250 or 300 gallons Second measure (Wall Insulation) saves 15% *of the remaining* fuel or cost. 15% of $750 ($1000 – 250 saved through attic insulation) = $112. 15% of 900 (1200 gallons minus 300 gallons saved through first measure) = 135 gallons. Wall Insulation thus saves $112 or 135 gallons. Total savings from both measures are $362 or 435 gallons, about 36% of the fuel bill.	

Incentives

After the customer has received a thorough energy audit, and has been given lists of product suppliers, installers and lenders, there should be some retrofit action. Sometimes, though, utilities faced with customer inertia must take a more active role. One California utility offers customers, along with the audit results a package including one tube of caulking, samples of foam rope and weatherstripping for windows and doors, sample plastic sheeting for do-it-yourself storm windows, and a booklet that explains in detail how to save energy by retrofitting.

Other public power systems travel with sample materials in a display portfolio and demonstrate various kinds of conservation measures to the customer. Many give away small items such as shower flow restrictors and electric outlet gaskets. Others sell measures such as water heater insulation jackets at wholesale cost – and then help the customer install it right there and then.

APPA Audit Program Management Manual

Conservation Investment Worksheet

			$	Quantity
1.	Fuel Bill:	this year estimate		
		last year		

2. Investments:

Measure	$ Savings	Qty. Savings
a.		
b.		
c.		
d.		
e.		
f.		
TOTALS:		

3. Payback – Return on Investment:

Cost of Installations: $ ____________________
Estimated Savings: $ ____________________
Difference: $ ____________________ (divided by annual fuel bill = __________ year payback)
Return on Investment: $ ____________________ (savings divided by cost = _______ %)

4. Comparison:

Return on Conservation Investments: ____________ % Tax Free
Savings Account: ____________ % Taxable
Other Investments: ____________ % Taxable

DISCLOSURE:

THE PROCEDURES USED TO MAKE THESE ESTIMATES (ARE CONSISTENT WITH DEPARTMENT OF ENERGY CRITERIA FOR RESIDENTIAL ENERGY AUDITS) OR (HAVE BEEN EVALUATED BY THE STATE FOR ACCURACY). HOWEVER, THE ACTUAL INSTALLATION COSTS YOU INCUR AND ENERGY SAVINGS YOU REALIZE FROM INSTALLING THESE MEASURES MAY BE DIFFERENT FROM THE ESTIMATES CONTAINED IN THIS AUDIT REPORT. ALTHOUGH THE ESTIMATES ARE BASED ON MEASUREMENTS OF YOUR HOUSE, THEY ARE ALSO BASED ON ASSUMPTIONS WHICH MAY NOT BE TOTALLY CORRECT FOR YOUR HOUSEHOLD.

MANAGEMENT

This section of the manual will show a small utility how to keep track of its program: how to manage its budget, evaluate the effectiveness of the program, and keep the records that government agencies will require.

The ongoing program management system is basically an extension of the *planning* phase of the utility energy audit program, particularly the program plan task, described earlier. Before reading this section, it would be a good idea to review the program plan task.

The *Management* section below will focus on four tasks:

I. Budget

II. Evaluation

III. Record-keeping

IV. Reporting

I. BUDGET

The first task in managing the utility energy audit program is to make sure that the program is operating on, or under, budget. In order to do this, a utility should develop a simple budget tracking form, to be used at the end of each month. For a small utility, the budget form is easy to use.

A basic budget form is included on the following page. In completing this form, it is important to take into account an appropriate allocation of expenses, even when no cash changes hands. For instance, on the budget form, the manager keeps track of rent, phone costs, etc. In a ten-person office, in which one person works half-time on the audit program, five percent of these general overhead expenses should be allocated to the energy audit program.

II. EVALUATION

The second task in managing the utility Home Audit Program is to evaluate the program's effectiveness. This evaluation is a three-step procedure.

APPA Audit Program Management Manual

Monthly Budget Record

	Bdgt. Hours	Actual Hours	Bdgt. Dollars	Actual Dollars	Diff. Hours	Diff. Dollars
Utility Budget Government Grants Local State Federal Audit Fees TOTAL INCOME						
Auditors Clerical Temp. Retrofit Other TOTAL PERSONNEL						
Rent Phones Equipment Forms/Materials Computer Transport Misc. Supplies TOTAL OFFICE						
Purchase Materials Public Communications TOTAL MKTG./COMM.						
Seminar Fees Lodging Meals Transportation Miscellaneous TOTAL TRAINING						
TOTAL EXPENSES						

NET

Customer Satisfaction

Keeping a finger on what the customer needs in the way of energy conservation advice and assistance is the best way to assure the continued success of your home energy audit program. Even the best-designed program should be reviewed periodically. Survey your utility customers in order to evaluate staff performance and various program elements. Revise, improve, or eliminate where necessary.

Results

Objective program results can be charted in terms of audits, installations, and estimated energy conservation. In many large utility Home Audit Programs, keeping track of the results, in terms of installations and actual energy conservation, is a very difficult job. For a small utility, however, which has organized a Home Audit Program involving the whole community, charting results is not a difficult task.

It is easy for the utility to record how many energy audits are performed during a month, or a quarter. The names of customers receiving audits should be recorded on a mailing list, typed in a format so that the names can be xeroxed onto mailing labels. Sources of energy audits should be recorded to determine the effectiveness of various public communications programs.

In order to track installations, the utility should regularly re-contact all of its customers who have received audits, by simply mailing a two-part postcard, using xeroxed mailing labels from the typed list of audit customers. The two-part postcard, a sample of which is shown on the next page, will ask homeowners to record which of the recommended improvements they have undertaken. The homeowner can fill out the card in a minute and drop it in the mailbox. If the utility does not get an adequate response from the postcard mailing, follow-up phone calls can be used to gather the same information.

The record of how much energy has been saved as a result of the energy audit program can be gathered in two ways. The first, and easiest, will occur if the utility supplies the heating fuel to the audited customer. The utility can easily track the customer's heating fuel usage and record what has been saved. For customers who use a heating fuel not supplied by the utility, the same double postcard system used to gather installation information can be used for energy conservation information. The customer is asked to check the appropriate fuel and record fuel bills for the current and previous years.

APPA Audit Program Management Manual

Sample Results Tracking Postcard

Dear Homeowner:

Thank you for participating in our Home Audit Program. We would like to know if you have made any energy-conserving installations, or have noticed any energy savings, as a result of the energy audit. Please take a moment and fill out the attached, postage-paid card.

Improvement

____ Attic Insulation
____ Wall Insulation
____ Floor Insulation
____ Caulking
____ Weatherstripping
____ Storm W/D
____ Furnace/Boiler
____ Pipe/Duct Insulation
____ Other

	Fuel Bills	
	Last Yr.	This Yr.
Oct.		
Nov.		
Dec.		
Jan.		
Feb.		
Mar.		
Apr.		
TOTAL		

Type Fuel ____________________

Cost Effectiveness

Once the results of the energy audit program are known, for any period of time, and the budget figures have been verified, the next step is to evaluate the cost effectiveness of the energy audit program. This evaluation is simply a matter of putting the costs alongside the results and making some judgments about the value of the services offered.

The cost effectiveness of a utility energy audit program can be measured in a number of ways. The most fundamental is a comparison of the value of the energy saved as a result of the program versus the costs of the program. A second measure, somewhat more difficult to determine, is the total economic value of the energy audit program. This value can be approximated by looking at the value of the installations which result from the energy audits.

The following page outlines an evaluation technique which many utilities may find useful. It should, of course, be modified to meet the needs of the individual utility.

If a utility finds that its program is not very cost effective, that it is not convincing homeowners to invest in energy-conserving improvements, it may wish to invest in some sales training for energy auditors. Utilities must remember that many of the ideas and installations suggested to homeowners are new, and violate established homeowner preconceptions and practices. They must be "sold" if they are to be adopted.

In the final analysis, however, a utility may simply have to live with a Home Audit Program that is not cost effective. Public pressure or public need may force program continuation, even if a strict cost/benefit analysis cannot justify it.

III. RECORD-KEEPING

The third task in the ongoing management of the Home Audit Program is keeping adequate records, both for local agencies which will be monitoring energy audit programs, and for the future use of the utility.

Individual Homes

For a small utility, the record-keeping tasks are fairly simple. The principal records are the case files for the individual customers whose homes have been audited. A utility should be very careful to keep accurate records of every contact with the homeowner, with a contractor making improvements on the home, or with a material supplier who has sold products to the home.

A file folder should be kept for every home. The file folder should include, at a minimum, the initial homeowner inquiry form, a copy of the audit checklist, and copies of any subsequent correspondence with the homeowner. In addition, any correspondence with contractors or suppliers, or any notes of phone conversations with either the homeowner or contractors/suppliers should be retained.

A convenient way to keep track of all of the records is to assign each homeowner a number, and to keep a separate file with cards, in alphabetical order, for each homeowner. Each card should contain the homeowner's name, address, and phone numbers, the date of the audit, and the homeowner's case number.

Total Program

The essential records for the entire Home Audit Program are those outlined in the two sections above, budget and evaluation. A utility which keeps these records, in a form close to that suggested above, on a monthly basis, will have the records it needs for the total program.

APPA Audit Program Management Manual

Cost Effectiveness Evaluation

1. Summary of Results

   a. Audits Performed

   b. Improvements Made

	Home Needing Improvements	Improvements Made
Attic Insulation		
Wall Insulation		
Floor Insulation		
Pipe/Duct Insulation		
Caulking		
Weatherstripping		
Furnace/Boiler Work		
Storm Windows/Doors		
Other		

   c. Energy Saved

	Quantity	BTUs	Dollars
Fuel			
Oil			
Gas			
Electricity			
Coal			
Wood			
Other			

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Cost Effectiveness Evaluation Continued

2. Summary of Costs

Utility Costs ______________________

Local Government Cost ______________________

Volunteer Costs ______________________

Other Costs ______________________

TOTAL COST ______________________

3. Comparisons

$\frac{\text{TOTAL COST}}{\text{Number of Audits}}$ = __________ = __________ Cost Per Audit

$\frac{\text{TOTAL SAVINGS}}{\text{Number of Audits}}$ = __________ = __________ Average Savings Per Audit

$\frac{\text{VALUE OF INSTALLATIONS}}{\text{Number of Audits}}$ = __________ = __________ Work Generated Per Audit

For each fuel $\frac{\text{TOTAL SAVINGS (Qty.)}}{\text{Cost of Audits}}$ = __________ = __________ Unit Cost of Fuel Saved

---

IV. REPORTING

There are two kinds of reporting which must concern the managers and operators of the utility energy audit program:

- Reports to Governing Board

- Reports to the Public (Ratepayers)

A utility which has followed the record-keeping and evaluation procedures suggested above will have very little difficulty in writing excellent reports in either category. The reports, however, will be different for each audience. A discussion of the significant differences follows below.

Reports to Governing Board

Reports to the utility governing board, or to the immediate superiors of the utility staff person responsible for the Home Audit Program, will essentially be recaps of the program plan outlined earlier. The reports, if possible, should be in an absolutely regular format, consistent with the program plan and normal utility internal procedures. The audit program staff person should try to take the initiative in submitting reports, rather than waiting for the board or superiors, to demand one.

The ultimate report to superiors or the board is the budget request or budget justification for the next year's program. Energy audit staff people should refer back to the program plan section of the manual. The budget request for year two should be in the same form as that for year one. The changes will be due to operating experience. Hopefully there will be successes to demonstrate the value of the program. In addition, the lessons learned and mistakes made should be laid out, in much the same way that the initial research is discussed in the program plan. Objective discussions of problems and solutions will persuade superiors that the operating staff people know what they are doing.

Reports to the Public (Ratepayers)

The utility Home Audit Program should make regular reports on its results to the public. Besides the beneficial public relations derived from these regular reports, utility staff people have an obligation to the ratepayers to keep them informed.

The form of the audit program reports to the public is important. So is the person who makes the announcements, or issues the press releases. Utility managers, town mayors, and local citizen advisory board members should all be involved in presenting results of the program to the public.

When issuing press releases or making public reports, it is always a good idea to remember that press people like to have assistance in completing their tasks. The hard work in the newspaper or radio business is research – digging out the story and getting the facts straight. The Home Audit Program will get much better press coverage of its reports, and its success, if it gives the press a full news release and plenty of background information. Package the information attractively. Add a glossy photo or two if they are available. Any effort that you make should be rewarded with good press coverage.

APPENDICES

- Appendix A. Energy Conservation Savings Estimates
  - Palo Alto Municipal Utilities
  - "Typical" savings estimates – government and industry sources
  - Retrofit Economics – University of Texas Center for Energy Studies
- Appendix B. Impact of Conservation on Utility Loads
  - Excerpt from *Residential Energy Conservation*, Office of Technology Assessment, U.S. Congress
- Appendix C. Sample Job Descriptions
- Appendix D. Sample Conservation Budgets
- Appendix E. Energy Audit Forms
  - Gainesville (Florida) Regional Utilities
  - City Utilities of Springfield, Missouri
  - City of Palo Alto (California) Utilities Department
  - Greenville (North Carolina) Utilities Commission
- Appendix F. Survey Form for Local Lending Institutions
- Appendix G. Sample List of Local Suppliers, Contractors
- Appendix H. Fact Sheet – Low Income Weatherization Program
- Appendix I. Fact Sheet – Residential Conservation Service (RCS) Program
- Appendix J. Sample Installation Specifications
- Appendix K. Do-It-Yourself Consumer Information Sheets
- Appendix L. Directory of State Energy Offices and Directory of Energy Extension Service Offices

Appendices (continued)

Appendix M. Utility Home Audit Programs – Case Histories and Procedures

- Tennessee Valley Authority
- City Utilities of Springfield, Missouri
- Pacific Power and Light Company
- Palo Alto, California Municipal Utilities
- Greenville, North Carolina Utilities Commission
- Cedar Falls, Iowa Municipal Utilities

APPENDIX A

ANNUAL SAVINGS BY INSTALLING CEILING INSULATION TO R-19

If you have no ceiling insulation and you decide to install it to R-19 heat resistance value, you can assume you will save approximately 25 percent of your annual heating cost.

EXAMPLE: $205.00 x .25 = $51.25 annual heating savings.

To figure annual savings if you already have some insulation and you wish to add enough to bring it up to R-19, use the following formula:

EXAMPLE: Annual Heating Cost x Savings Factor = Estimated Heat Savings
$205.00 x .035 = $7.18
(Existing insulation in this case is R-7)

Savings Factor

If you have R-3 = .082
R-7 = .035
R-11 = .016
R-13 = .011
R-16 = .004

To figure existing R value, use the coverage chart included in this packet. If you already have R-11 in your attic, the payback period will be very long if you insulate to R-19.

ANNUAL SAVINGS BY LOWERING THERMOSTAT

To determine annual heating savings by lowering the thermostat, multiply your annual cost for heating by the number of degrees turned down by four percent.

EXAMPLE: Annual Heating Cost x (72°-65°) x 4% = Annual Heat Savings
$205.00 x 7 x .04 = $57.40

If you lower your thermostat at night, you will save even more.

EXAMPLE: Annual Heating Cost x (65°-55°) x 1% for each degree lower than 65°
$205.00 x 10 x .01 = $20.50

MUNICIPAL UTILITIES

SAVINGS CALCULATIONS WORKSHEET

The following calculations are provided to help homeowners calculate the amount of money spent yearly to heat their houses.

1. List all of the costs for gas or electricity (depending on whether you heat your home with gas or electricity) next to the corresponding month.

EXAMPLE:

Months	Costs
Jan.	$50.00
Feb.	50.00
Mar.	40.00
Apr.	40.00
May	30.00
June	17.00
July	15.00
Aug.	13.00
Sept.	15.00
Oct.	35.00
Nov.	35.00
Dec.	45.00

2. Figure the average cost charged for the summer months (June through September).

June	$17.00
July	15.00
Aug.	13.00
Sept.	15.00
	$60.00/4 months = $15.00

This is the amount it costs each month for energy not used for heating (since you normally do not heat your house in the summer months). It is referred to as "base load". *

3. Subtract this average from the remaining months' charges:

Month	Monthly Charge		Base Load		Cost to Heat
Jan.	$50.00	-	$15.00	=	$35.00
Feb.	50.00	-	15.00	=	35.00
Mar.	40.00	-	15.00	=	25.00
Apr.	40.00	-	15.00	=	25.00
May	30.00	-	15.00	=	15.00
Oct.	35.00	-	15.00	=	20.00
Nov.	35.00	-	15.00	=	20.00
Dec.	45.00	-	15.00	=	30.00
					$205.00

* If you own a pool, subtract gas usage for pool heater.

4. Add the listed monthly "Cost to Heat" figures.

   $205.00 is the approximate amount of money it cost to heat this home for one year.

March, 1978

GENERAL ANNUAL DOLLAR SAVINGS

MAJOR CONSERVATION MEASURES*

	Energy Savings Annually	
	Percent	Dollars
Insulate ceiling to R-19	25	$55.00
Seal all exterior windows, doors, and cracks by caulking and weatherstripping	20	44.00
Lower thermostat setting from 72° to 65° in the daytime	25	55.00
Reduce nighttime temperature from 65° to 55°	10	22.00
Raise air-conditioning thermostat from 72° to 78°	25	24.00
Lower hot water temperature by 20°	7	6.00
Install hot water heater insulating blanket	7	6.00
Convert incandescent lights used more than four hours per day to fluorescent	50(of energy used for unconverted lights)	15.00

* This list does not take into account the cost effectiveness of each measure. Each item's energy savings must be taken separately. It must be assumed that each house has different energy requirements, and, therefore, this list should be used as a general guideline only and not for specific information.

resource
PALO ALTO
conservation

MUNICIPAL UTILITIES

A.2

SUMMARY OF CONSERVATION SAVINGS ESTIMATES

Sources	Attic	Doors and Windows	Weatherstripping and Caulking	Total
Brookhaven National Lab	10-37%	← 20% →		44%
Community Services Administration	15%	← 20% →		35%
Federal Energy Administration I	28%	NEA	NEA	NEA
Federal Energy Administration II	7%	NEA	15%	NEA
Homeowner's Energy Guide	34%	8%	22%	64%
U. S. Department of Housing and Urban Development	12-32%	2-11%	10-24%	45%
National Bureau of Standards	13%	NEA	NEA	NEA
New York State Public Service Commission	13%	NEA	NEA	NEA
Princeton University	NEA	NEA	NEA	25%
University of Wisconsin	5-20%	15-20%	18-28%	49%
Averages	19%	11.2%	18%	43.6%

NEA = No Estimate Available

SOURCES/ESTIMATES OF CONSERVATION SAVINGS

Brookhaven National Lab	*A Perspective on the Energy Future of the Northeast United States*, "Residential and Commercial Energy Demand," John Lee, March, 1976
Community Services Administration	*Save Energy, Save Money*, Institute on Energy Conservation and the Poor, Office of Economic Opportunity, December, 1974
Federal Energy Administration I	*Conservation Investments by Gas Utilities Can Be Considered a Gas Supply Option*, Federal Energy Administration, William Rosenberg, December 17, 1976
Federal Energy Administration II	*Project Retrotech*, "Home Weatherization Manual," Office of Weatherization for Low Income, Federal Energy Administration, May, 1976
Homeowner's Energy Guide	*Homeowner's Energy Guide*, John A. Murphy, Thomas Y. Crowell Company, New York, 1976
U. S. Department of Housing and Urban Development	*In the Bank, or Up the Chimney?* Office of Policy Development and Research, Division of Energy, Building Technology and Standards, U.S. Department of Housing and Urban Development, April, 1975
National Bureau of Standards	*Retrofitting Existing Housing for Energy Conservation: An Economic Analysis*, Center for Building Technology, Institute of Applied Technology, National Bureau of Standards, Stephen R. Peterson, December, 1974
New York State Public Service Commission	"Summary of Utility Financed Energy Conservation Plans," New York State Public Service Commission, Joseph Rizzuto, February, 1977
Princeton University	"Energy Conservation in Existing Housing: Your Home Deserves a House Call," Center for Environmental Studies, Princeton University, Robert H. Socolow, May, 1976
University of Wisconsin	"Energy Conservation Techniques in Residential Space Heating," Marine Studies Center, Institute for Environmental Studies, University of Wisconsin, Madison, John Steinhart *et al.*, *draft*, March, 1977

Economics of Retrofitting for Energy Conservation

9

9.1 Introduction

The homeowner of today has at his disposal a large number of energy-saving devices and techniques. Investment possibilities range from no-cost, immediate-results techniques such as higher thermostat settings during the cooling season to high-cost, long-term payback investments such as solar collectors for absorption air conditioners. The level at which a particular homeowner decides to become involved in energy conservation depends on his motivation, which is a complex interaction of a number of factors. The homeowner may decide to act for reasons of social prestige (to keep ahead of the Joneses), patriotic duty (to lessen our dependence on foreign sources), macroeconomics (to bolster our economy and increase the value of the dollar), curiosity (to explore the latest gadgetry), concern for the future (to conserve our finite natural resources), or even conscience or frugality (to avoid being wasteful). The strongest and most pervasive motivation for energy conservation remains personal economics--the possibility of saving money. The following discussion outlines a simplified method of evaluating the economic attractiveness of a considered improvement, both by itself and in comparison with alternatives.

Analytical portions of this chapter were written by Nichols and Associates, Inc., Austin, Texas.

James A. Broughton, Carl A. Crow, and Jerold W. Jones, Texas Energy Management, Training Manual for Home Energy Analysis Training Program/Energy Conservation in Existing Residences, University of Texas Center for Energy Studies, Austin, Texas.

9.2 Costs

In order to estimate the true cost of an investment, the interest paid on a loan or the interest lost on money withdrawn from savings must be taken into account. This amount represents an expenditure above and beyond the initial cost of whatever improvement is made. The added cost of interest depends upon the rate of interest and duration of the loan and can be calculated by using a total payment factor (tables 9.2-1 and 9.2-2). The total payment factor multiplied by the initial cost of the investment gives the total cost of the investment (initial cost plus cost of interest). The following examples show how to calculate the total cost using the total payment factor.

A. Initial total cost including equipment, materials, and labor $________

B. If the money is to be borrowed at ___% per year with ___equal payments, then table 9.2-1 gives a total payment factor. The first part of the table is based on one payment each year, and the second part is based on one payment each month.* ________

---

*The actual amount of each equal payment may be obtained by dividing the product of this factor and the value from A by the number of payments.

OR:

If the money is not to be borrowed, but withdrawn from a savings account, then no additional costs are incurred from interest due on a loan, but a cost is incurred from interest that will not be earned by the money that is withdrawn. From table 9.2-2 find the annual interest rate that the savings would draw, select the compounding term and the number of years that the savings would be unavailable, and enter the figure from the table here. ____________

C. The value from part A times the factor from either part of B gives the total cost of the improvement, including the cost of capital. A x B = $____________

Table 9.2-1. Total Payment Factor for Improvements Made with Borrowed Money

Years	Equal Annual Payments Yearly Interest Rate (%)										
	8	9	10	11	12	13	14	15	16	17	18
1	1.080	1.090	1.100	1.110	1.120	1.130	1.140	1.150	1.160	1.170	1.180
2	1.1216	1.1370	1.1524	1.1678	1.1834	1.1990	1.2146	1.2302	1.2460	1.2616	1.2774
3	1.1640	1.1853	1.2063	1.2276	1.2489	1.2705	1.2921	1.3140	1.3359	1.3578	1.3797
4	1.2076	1.2348	1.2620	1.2892	1.3168	1.3448	1.3728	1.4012	1.4296	1.4580	1.4868
5	1.2525	1.2855	1.3190	1.3530	1.3870	1.4215	1.4565	1.4915	1.5270	1.5630	1.5990
6	1.2978	1.3380	1.3776	1.4184	1.4592	1.5012	1.5432	1.5852	1.6284	1.6716	1.7154
7	1.3447	1.3909	1.4378	1.4854	1.5337	1.5827	1.6324	1.5828	1.7332	1.7843	1.8368
8	1.3920	1.4456	1.4992	1.5544	1.6104	1.6672	1.7248	1.7832	1.8416	1.9016	1.9616
9	1.4409	1.5012	1.5624	1.6254	1.6893	1.7541	1.8198	1.8864	1.9539	2.0223	2.0916
10	1.490	1.558	1.627	1.698	1.770	1.843	1.917	1.993	2.069	2.147	2.225

Table 9.2-1. (continued)

Months	Equal Monthly Payments Yearly Interest Rate (%)										
	8	9	10	11	12	13	14	15	16	17	18
12	1.0439	1.0494	1.0550	1.0606	1.0662	1.0718	1.0774	1.0831	1.0888	1.0945	1.1002
18	1.0645	1.0728	1.0810	1.0893	1.0977	1.1061	1.1145	1.1229	1.1314	1.1399	1.1485
24	1.0855	1.0964	1.1075	1.1186	1.1298	1.1410	1.1523	1.1637	1.1751	1.1866	1.1982
30	1.1066	1.1204	1.1343	1.1483	1.1624	1.1766	1.1910	1.2054	1.2199	1.2345	1.2492
36	1.1281	1.1448	1.1616	1.1786	1.1957	1.2130	1.2304	1.2480	1.2657	1.2835	1.3015
48	1.1718	1.1945	1.2174	1.2406	1.2640	1.2877	1.3117	1.3359	1.3603	1.3850	1.4100
60	1.2166	1.2455	1.2748	1.3045	1.3347	1.3652	1.3961	1.4274	1.4591	1.4912	1.5236
72	1.2624	1.2978	1.3339	1.3705	1.4076	1.4453	1.4836	1.5224	1.5618	1.6017	1.6422
84	1.3092	1.3515	1.3945	1.4383	1.4828	1.5281	1.5742	1.6209	1.6684	1.7166	1.7655
96	1.3571	1.4064	1.4567	1.5080	1.5603	1.6135	1.6677	1.7228	1.7788	1.8357	1.8934
108	1.4060	1.4626	1.5205	1.5796	1.6399	1.7014	1.7640	1.8278	1.8927	1.9587	2.0257
120	1.4559	1.5201	1.5858	1.6530	1.7217	1.7917	1.8632	1.9360	2.0102	2.0856	2.1622

Table 9.2-2. Total Payment Factor for Improvements Made with Money Withdrawn from Savings

	5.0% per Year Compounded			5.5% per Year Compounded		
Years	Annually	Quarterly	Daily	Annually	Quarterly	Daily
1.0	1.0500	1.0509	1.0513	1.0550	1.0561	1.0565
2.0	1.1025	1.1045	1.1051	1.1130	1.1154	1.1163
3.0	1.1576	1.1608	1.1618	1.1742	1.1781	1.1794
4.0	1.2155	1.2199	1.2214	1.2388	1.2442	1.2461
5.0	1.2763	1.2820	1.2840	1.3070	1.3141	1.3165
6.0	1.3401	1.3474	1.3498	1.3788	1.3878	1.3909
7.0	1.4071	1.4160	1.4190	1.4547	1.4658	1.4696
8.0	1.4775	1.4881	1.4918	1.5347	1.5481	1.5527
9.0	1.5513	1.5639	1.5683	1.6191	1.6350	1.6404
10.0	1.6289	1.6436	1.6487	1.7081	1.7268	1.7331

	6.0% per Year Compounded			6.5% per Year Compounded		
Years	Annually	Quarterly	Daily	Annually	Quarterly	Daily
1.0	1.0600	1.0614	1.0618	1.0650	1.0666	1.0672
2.0	1.1236	1.1265	1.1275	1.1342	1.1376	1.1388
3.0	1.1910	1.1956	1.1972	1.2079	1.2134	1.2153
4.0	1.2625	1.2690	1.2712	1.2865	1.2942	1.2969
5.0	1.3382	1.3469	1.3498	1.3701	1.3804	1.3840
6.0	1.4185	1.4295	1.4333	1.4591	1.4724	1.4769
7.0	1.5036	1.5172	1.5219	1.5540	1.5704	1.5761
8.0	1.5938	1.6103	1.6160	1.6550	1.6750	1.6819
9.0	1.6895	1.7091	1.7159	1.7626	1.7866	1.7949
10.0	1.7908	1.8140	1.8220	1.8771	1.9056	1.9154

Table 9.2-2. (continued)

	7.0% per Year Compounded			7.5% per Year Compounded		
Years	Annually	Quarterly	Daily	Annually	Quarterly	Daily
1.0	1.0700	1.0719	1.0725	1.0750	1.0771	1.0779
2.0	1.1449	1.1489	1.1503	1.1556	1.1602	1.1618
3.0	1.2250	1.2314	1.2337	1.2423	1.2497	1.2523
4.0	1.3108	1.3199	1.3231	1.3355	1.3461	1.3498
5.0	1.4026	1.4148	1.4190	1.4356	1.4499	1.4549
6.0	1.5007	1.5164	1.5219	1.5433	1.5618	1.5682
7.0	1.6058	1.6254	1.6322	1.6590	1.6823	1.6904
8.0	1.7182	1.7422	1.7506	1.7835	1.8120	1.8220
9.0	1.8385	1.8674	1.8775	1.9172	1.9518	1.9639
10.0	1.9672	2.0016	2.0136	2.0610	2.1023	2.1168

	8.0% per Year Compounded			8.5% per Year Compounded		
Years	Annually	Quarterly	Daily	Annually	Quarterly	Daily
1.0	1.0800	1.0824	1.0833	1.0850	1.0877	1.0887
2.0	1.1664	1.1717	1.1735	1.1772	1.1832	1.1853
3.0	1.2597	1.2682	1.2712	1.2773	1.2870	1.2904
4.0	1.3606	1.3728	1.3771	1.3859	1.4000	1.4049
5.0	1.4693	1.4859	1.4918	1.5037	1.5228	1.5295
6.0	1.5869	1.6084	1.6160	1.6315	1.6564	1.6652
7.0	1.7138	1.7410	1.7506	1.7701	1.8018	1.8129
8.0	1.8509	1.8845	1.8963	1.9206	1.9599	1.9737
9.0	1.9990	2.0399	2.0543	2.0839	2.1318	2.1488
10.0	2.1589	2.2080	2.2253	2.2610	2.3189	2.3394

9.3 Savings

The actual annual dollar savings that will be realized by a homeowner depends upon the energy saved during a year and the cost of utilities. Perhaps the most difficult task the energy adviser will face is estimating annual dollar savings, for this figure is, of course, dependent upon a reliable estimate of energy savings. The estimates of energy savings should be derived from examination of the case studies presented in chapter 3 and from analysis of at least one year's utility bill records. The adviser can then roughly judge the accuracy of the case study data applied to a particular residence. For example, some homeowners are extremely energy conscious and may adjust their lifestyle to combat high energy costs by using very little heating and cooling. In spite of apparent energy conservation deficiencies in such a home, the actual cost of utilities may be quite low, a situation which would be reflected in the utility bill records. These factors must be considered in giving estimates of energy savings to the homeowner. The adviser would certainly not want to estimate energy savings in excess of the actual energy consumed in a home! The procedure of analyzing utility bill records given in appendix 8.1-A is essential to the adviser's task of providing reliable information to the homeowner.

The estimate of the first year's dollar savings resulting from a home improvement is based upon current costs of energy. In order to estimate the savings over a period of several years, the escalation rate of utility costs must be considered. Escalating costs will cause greater dollar savings to be realized in future years than would be expected if current utility costs alone are used for the estimate. The estimate of total dollar savings over the useful life or period of investment (duration of loan) of the improvement can be calculated by using an escalation factor (table 9.3-1). This factor is multiplied by the first year's dollar savings to arrive at the total dollar savings for the improvement during the period of time considered.

The following material explains the procedure for calculating the total dollar savings for an improvement. Part E also explains the usefulness of accounting for salvage value and/or recoverable improvement costs as part of the total dollar savings.

A. Estimated annual savings in Btu from the improvement ____________Btu/year
and/or
Estimated annual savings in kwh from the improvement ____________kwh/year
____________ccf/year

B. Current price of energy per Btu ____________$/Btu
and/or
Current price of energy per kwh ____________$/kwh
____________$/ccf

C. Either energy savings value from A, multiplied by the appropriate price of energy per unit from B yields the current annual dollar savings from the improvement $____________

D. The price of energy over the lifetime of the improvement can be expected to escalate rather than to remain constant.* From table 9.3-1, select an expected escalation rate, then select the expected lifetime of the improvement, and obtain an escalation factor. Multiply this factor by the answer from C to obtain a truer estimate of the total dollar savings from the improvement over its expected lifetime.

__________escalation factor

$__________

*If the price of energy were to remain constant over the lifetime of the improvement, the annual dollar savings from C could simply be multiplied by the expected lifetime to obtain the total expected dollar savings.

E. Some improvements (such as a new energy-efficient refrigerator or range) may be sold or traded before they are completely worn out. At that time, the improvement will have some amount of salvage value. If a salvage value is expected, it can be added to the total savings from part D (D + salvage value). $__________

Some improvements, such as added insulation, storm windows and storm doors, become part of the house and thus increase the value of that house. Often the initial cost of such improvements is totally recoverable through a higher selling price for the home. For improvement costs that are expected to be recovered, the initial cost should be added to the total dollar savings (D + initial cost). $__________

Table 9.3-1. Escalation Factor

Years	Annual Escalation Rate (%)									
	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0500	2.0600	2.0700	2.0800	2.0900	2.1000	2.1100	2.1200	2.1300	2.1400
3	3.1525	3.1836	3.2149	3.2464	3.2781	3.3100	3.3421	3.3744	3.4069	3.4396
4	4.3101	4.3746	4.4399	4.5061	4.5731	4.6410	4.7097	4.7793	4.8498	4.9211
5	5.5256	5.6371	5.7507	5.8666	5.9847	6.1051	6.2278	6.3528	6.4803	6.6101
6	6.8019	6.9753	7.1533	7.3359	7.5233	7.7156	7.9129	8.1152	8.3227	8.5355
7	8.1420	8.3938	8.6540	8.9228	9.2004	9.4872	9.7833	10.0890	10.4047	10.7305
8	9.5491	9.8975	10.2598	10.6366	11.0285	11.4359	11.8594	12.2997	12.7573	13.2328
9	11.0266	11.4913	11.9780	12.4876	13.0210	13.5795	14.1640	14.7757	15.4157	16.0853
10	12.5779	13.1808	13.8164	14.4866	15.1929	15.9374	16.7220	17.5487	18.4197	19.3373
11	14.2068	14.9716	15.7836	16.6455	17.5603	18.5312	19.5614	20.6546	21.8143	23.0445
12	15.9171	16.8699	17.8884	18.9771	20.1407	21.3843	22.7132	24.1331	25.6502	27.2707
13	17.7130	18.8821	20.1406	21.4953	22.9534	24.5227	26.2116	28.0291	29.9847	32.0887
14	19.5986	21.0151	22.5505	24.2149	26.0192	27.9750	30.0949	32.3926	34.8827	37.5811
15	21.5786	23.2760	25.1290	27.1521	29.3609	31.7725	34.4054	37.2797	40.4175	43.8424
16	23.6575	25.6725	27.8880	30.3243	33.0034	35.9497	39.1899	42.7533	46.6717	50.9804
17	25.8404	28.2129	30.8402	33.7502	36.9737	40.5447	44.5008	48.8837	53.7391	59.1176
18	28.1324	30.9056	33.9990	37.4502	41.3013	45.5992	50.3959	55.7497	61.7251	68.3941
19	30.5390	33.7600	37.3790	41.4463	46.0185	51.1591	56.9395	63.4397	70.7494	78.9692
20	33.0659	35.7856	40.9955	45.7620	51.1601	57.2750	64.2028	72.0524	80.9468	91.0249

9.4 Comparisons

It is of interest to compare the rate of return on an investment in energy conservation to that on alternative investments such as savings accounts or savings bonds. Homeowners may be surprised to learn that the return on investment in energy conservation may far surpass any alternative.

The following section explains the calculation of simple percentage return on investment and annual rate of return on investment, and provides information for comparison of investments in energy conservation to other alternatives. The simple rate of return is the ratio of the total dollar savings (including salvage value) to the total cost of the investment less the total cost, expressed as a percentage. The annual return on investment is the percentage return for 1 year and can be compared to the annual yield of the various alternatives found in table 9.4-1.

A. The expected total energy dollar savings from an improvement (from part D of the savings section) divided by the total expected dollar cost of the improvement (from part C of the costs section) minus the total dollar cost gives a simple percentage return on investment*

[($ total savings ÷ $ total cost) -1] x 100 = % return. ______%

---

*Note that the rate of return will be negative for periods less than the payback period. A negative value does not indicate no savings were realized, but only that the investment did not pay for itself during the period of time considered.

B. The return on investment from part A is the total return on the investment. To obtain the annual rate of return on investment, divide the value obtained in A by the number of years in the lifetime of the improvements (% return ÷ useful life = % return per year).

______% per year

C. The simple rate of return on investment from B may or may not be a good investment from a personal economic standpoint. The money that is to be used for the energy-conserving improvement could also be used for other investments such as stock, bonds, and savings programs. Table 9.4-1 lists several investment alternatives with their typical rates of return. Compounded interest is sometimes difficult to compare with simple interest; therefore, figures 9.4-a, 9.4-b, and 9.4-c are included. For example, figure 9.4-a shows that if the rate of return on an improvement is 10% per year for 10 years, this amount is equivalent to a compounded interest of 7.2% compounded yearly for 10 years; figure 9.4-b shows that it is equivalent to 7.0% compounded quarterly for 10 years; and figure 9.4-c shows that it is equivalent to 6.9% compounded daily. Alternatively, if an 8% yearly compounding can be secured, approximately 9 years are required to earn as much as 10% simple interest for 10 years.

______%
compounded

Table 9.4-1. Comparison of Investment Alternatives

Investment	Simple Return on Investment (% per yr)	Rate (% per yr)	Compounded Frequency	Returns on Investment		Annual Yield (%)
				Minimum Amount	Time Duration	
U.S. savings bonds, series E		6.0	semi-annual	$18.75	5 years	6.88
Certificates of deposit		5.75	daily	$1,000	90 days	5.95
		6.50	daily	$1,000	1 year	6.71
		6.75	daily	$1,000	30 months	6.98
		7.50	daily	$1,000	4 years	7.79
		7.75	daily	$1,000	6 years	8.06
		8.0	daily	$1,000	8 years	8.33
Bank savings		5.0	daily			5.12
Savings & loan		5.25	daily			5.39
Credit union		6.0	quarterly			6.18
Credit union shares certificates		7.0	quarterly	$1,000	1 year	7.19
		7.25	quarterly	$5,000	6 months	7.45
Tax-free bonds						
Long-term A	6.5-6.6					
B-grade	7.0					
Taxable bonds						
Corporate bond	9.0					
B-grade	9.25-9.5					
Stocks						
Preferred	8.5-9.0					
Common	5.0					

Fig. 9.4-a. Conversion of Simple Interest to Yearly Compounded Interest

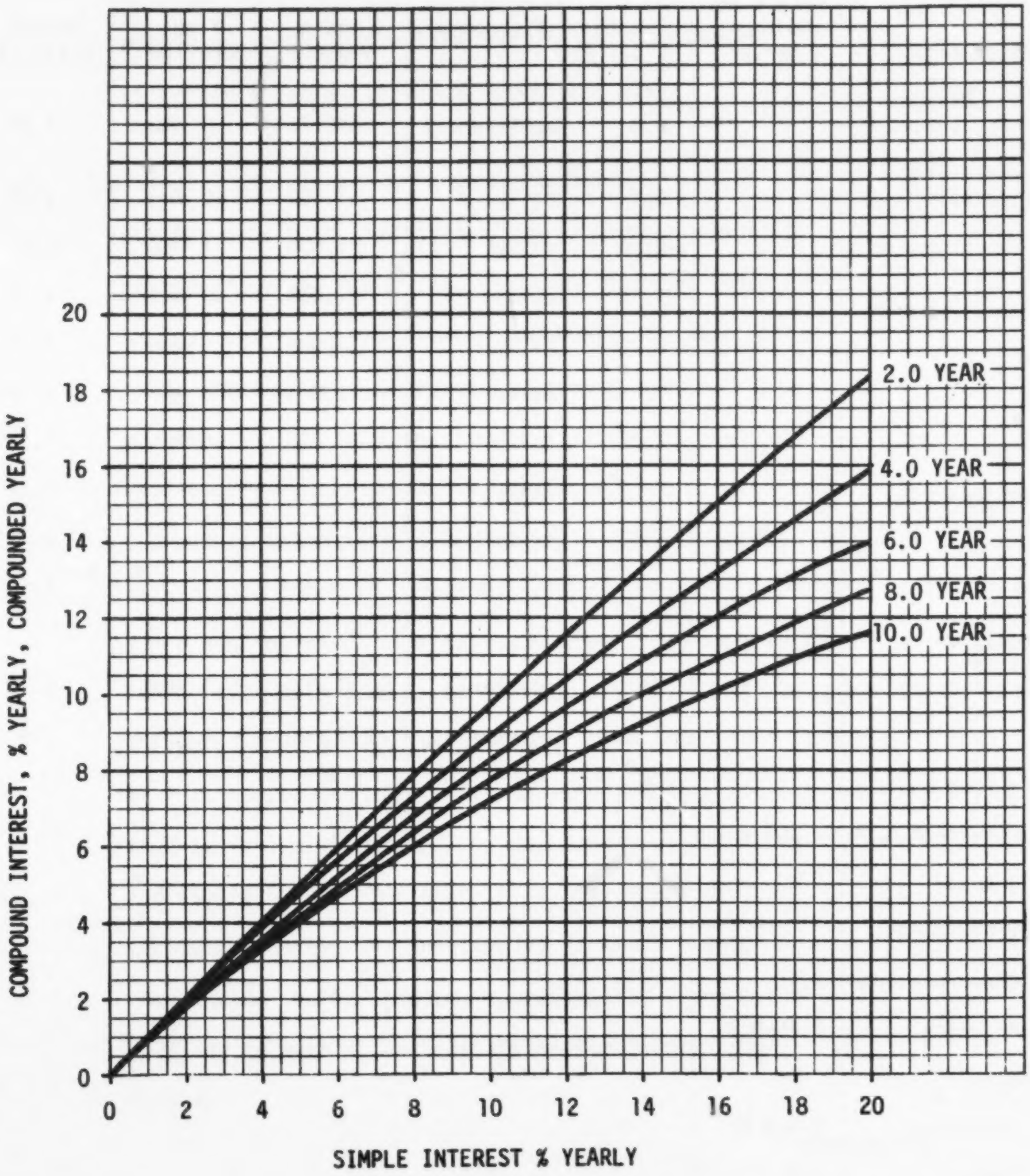


Fig. 9.4-b. Conversion of Simple Interest to Quarterly Compounded Interest

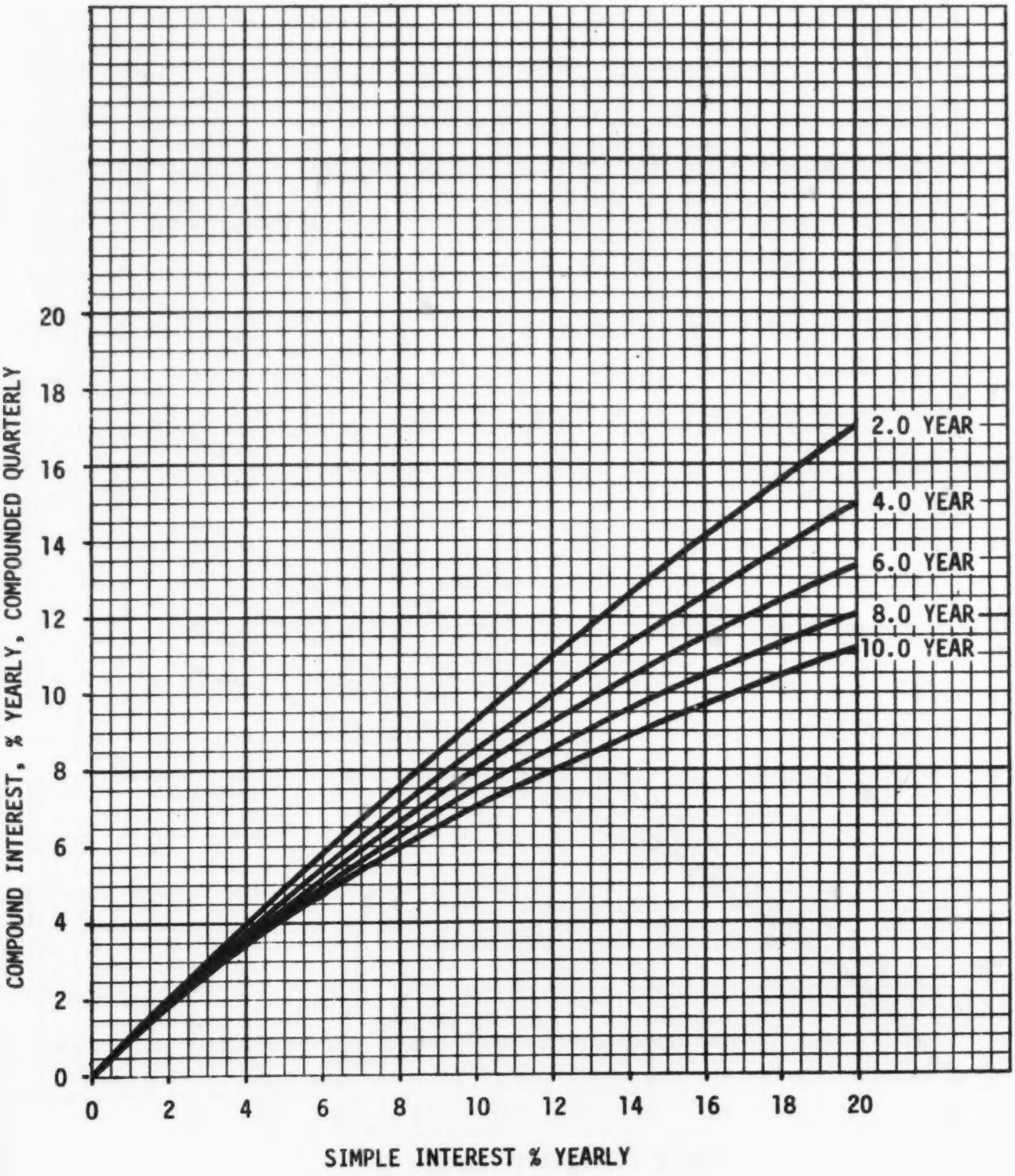
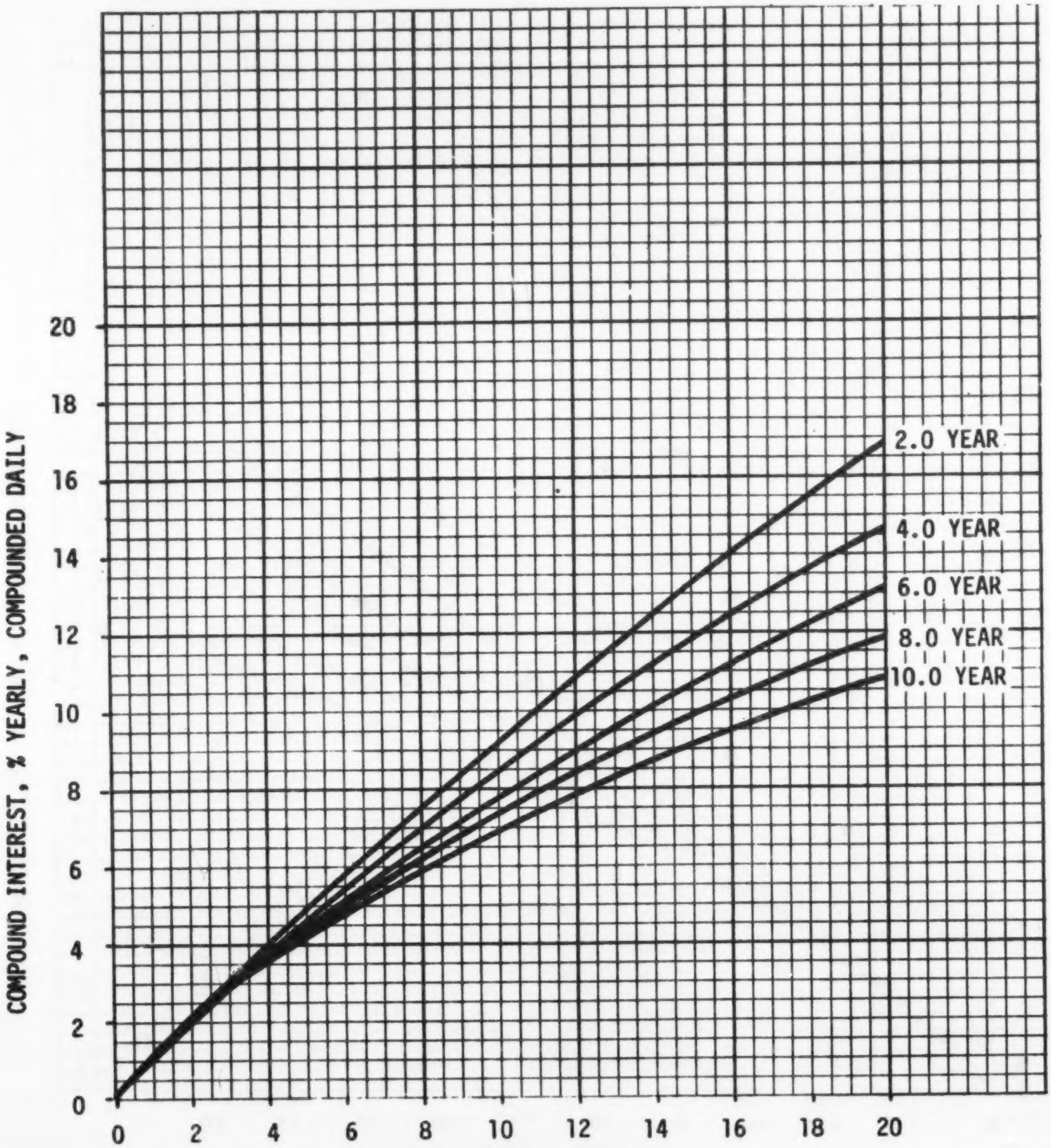


Fig. 9.4-c. Conversion of Simple Interest to Daily Compounded Interest



9.5 Payback and Break-Even Time

Many homeowners are familiar with expressing investments in terms of the length of time required for an investment to pay for itself the simple payback period. This simple calculation can be made by dividing the estimated first-year dollar savings into the cost of the investment. After he has gained some experience in estimating and has applied the information provided by this text to various homes in the field, the energy adviser can usually give the homeowner a reasonably accurate estimate of the simple payback period. This estimate will be meaningful to homeowners, yet it can be easily determined without tedious calculations. However, the economics calculations presented in this chapter should be studied because the adviser will gain confidence and be more effective in his advice to homeowners by calculating the economics of several investments and thus realizing what a good investment energy conservation can be.

The following material explains the calculation of the simple payback period and the payback period considering inflation. A quick calculation form is also provided, with an example following.

The time at which the total cumulative savings from an improvement exactly equal the total cost is called the payback or break-even point. Any time thereafter, the improvement has saved more money then it cost and is generating a profit, so to speak.

On the following Economics Short Form, note that the total cost was found in part 9.2.C and the first-year annual saving in part 9.3.C. The payback period can be found for a given rate of fuel cost escalation by referring to table 9.3-1 in section 9.3.

Assume that the total cost of an improvement is $1,000. Further assume that the improvement can save $50 in the first year of its operation. If the escalation rate is expected to be 8% per year, then refer to table 9.3-1, column 4 (the 8.0% column). Go down that column to the number closest to 20.00 ($1,000/$50), then go left to read the years column. In this case 20.0 lies somewhere between 12 and 13; therefore, at a point between 12 and 13 years (12.4 to be exact) the improvement should have saved enough in energy costs exactly to pay for itself, if all the assumptions are valid.

Simple payback equals the total cost divided by the current expected savings per year. ___________years

The payback, taking escalating utility costs into account is found by using table 9.3-1. ___________years

ECONOMICS SHORT FORM

9.2. Costs

A. Initial cost $ __________

B. Total payment factor

borrowed (table 9.2-1) $ __________

or drawn from savings (table. 9.2-2) $ __________

C. Total cost of improvement (A x B) $ __________

9.3. Savings

A. Estimated annual energy savings __________ Btu/year

or __________ kwh/year

__________ ccf/year

B. Current price of energy __________ $/Btu

or __________ $/kwh

__________ $/ccf

C. Current annual dollar savings (A x B) $ __________

D. Lifetime dollar savings __________ escalation factor

(C x escalation factor from table 9.3-1) $ __________

E. Total dollar savings (D + salvage value) $ __________

9.4. Comparisons

A. Total return on investment __________ %

[(9.3.E ÷ 9.2.C) -1] x 100

B. Annual return on investment (9.4.A ÷ useful life) __________ % per year

C. Compound return on investment

(figures 9.4-a, 9.4-b, and 9.4-c) __________ % per year

9.5. Payback or Break-Even time

A. Simple payback (9.2.C ÷ 9.3.C) __________ years

B. Payback considering escalation (table 9.3-1) __________ years

Example: A homeowner is considering the purchase of attic insulation for an initial purchase price of $400. Money is to be borrowed at 12% interest for 36 months with payments made in equal monthly installments. The estimated annual energy savings are 21 million Btu/yr for the heating season and 7 million Btu/yr for the cooling season. The local cost of fuel for the gas central heating system is $3.50 per Mcf and the cost of electricity for the air conditioning system is $0.048 per kwh. The price of fuel is expected to escalate at 8% per year. The homeowner expects to move at the end of 5 years and would like to know the return on investment for that time period. The example is shown on the economics short form which follows.

On line 9.2.A enter the initial cost of the investment ($400). The total payment factor (1.1957) is found in table 9.2-1 and entered on line 9.2.B. The total cost of the investment considering interest is entered on line 9.2.C. ($400 x 1.1957 = $478.28).

The estimated annual energy savings are discussed in chapter 3. The estimated annual heat loss/heat gain savings (28 million Btu/yr) from chapter 3 is converted to ccf* and kwh as follows:

$$\text{ccf/yr} = \frac{21 \times 10^6 \text{ Btu/yr}}{(0.60)\ (10^6 \text{ Btu/10 ccf})} = 350 \text{ ccf/yr}$$

$$\text{kwh/yr} = \frac{7 \times 10^6 \text{ Btu/yr}}{(2.0)\ (3413 \text{ Btu/kwh})} = 1025 \text{ kwh/yr}$$

where 0.60 and 2.0 are the heating and cooling system efficiencies.

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*1 Mcf (one thousand cubic feet) of gas is equivalent to 10 ccf (one hundred cubic feet).

The annual dollar savings are found by multiplying the cost of fuel by these energy savings estimates [($0.350/ccf x 350 ccf) + ($0.048/kwh x 1025 kwh) = $171.70]. Enter the energy savings and dollar savings estimates on lines 9.3.A and 9.3.C, respectively.

The dollar saving for the 5-year investment period with escalating fuel costs considered is calculated on line 9.3.D. The escalation factor is from table 9.3-1 (5.8666). The total savings for the 5-year period is $1008 ($172 x 5.8666 = $1008). A salvage value of $100 for the insulation is considered reasonable.

The total return on investment and annual return on investment are calculated and entered on lines 9.4.A and 9.4.B, respectively. The total return on the investment is [($1108 ÷ 478) - 1] x 100 = 131.8%. The annual return on investment is calculated by dividing the total return on investment by the investment period (132% ÷ 5 = 26.4%). No comparison of compound interest has been made because the annual return of investment is greater than those shown in figures 9.4-a, 9.4-b, and 9.4-c.

The payback or break-even time is calculated ($478 ÷ $172/yr = 2.8 years) and entered on line 9.5.A. The payback considering escalating fuel costs is found from table 9.3-1 and is entered on line 9.5.B.

ECONOMICS SHORT FORM

9.2. Costs

A. Initial cost $ 400

B. Total payment factor

borrowed (table 9.2-1) 1.1957

36 MONTHS AT 12% INTEREST

or drawn from savings (table. 9.2-2) ______

C. Total cost of improvement (A x B) $ 478

$400 × 1.1957 = $478

9.3. Savings

A. Estimated annual energy savings 28×10^6 Btu/year

COOLING: $\frac{7 \times 10^6 \text{ Btu/yr}}{(2.0)3413 \text{ Btu/kwh}} = 1{,}025$ kwh or 1,025 kwh/year

HEATING: $\frac{21 \times 10^6 \text{ Btu/yr}}{(0.60)10^6 \text{ Btu/}10\text{ccf}} = 350$ ccf 350 ccf/year

B. Current price of energy — $/Btu

or 0.048 $/kwh

0.350 $/ccf

C. Current annual dollar savings (A x B) $ 172

(1025 × 0.048) + (350 × 0.350) = $172

D. Lifetime dollar savings 5.8666 escalation factor

5-YEAR INVESTMENT PERIOD @ 8%

(C x escalation factor from table 9.3-1) $ 1,008

$172 × 5.8666 = $1,008

E. Total dollar savings (D + salvage value) $ 1,108

$1,008 + $100 = $1,108

9.4. Comparisons

A. Total return on investment 132 %

[(9.3.E ÷ 9.2.C) -1] x 100

[($1,108 ÷ $478) - 1] × 100 = 132%

B. Annual return on investment (9.4.A ÷ useful life) 26 % per year

132% ÷ 5 = 26% PER YEAR

C. Compound return on investment

(figures 9.4-a, 9.4-b, and 9.4-c) — % per year

9.5. Payback or Break-Even time

A. Simple payback (9.2.C ÷ 9.3.C) 2.8 years

$478 ÷ $172/yr = 2.8

B. Payback considering escalation (table 9.3-1) 2.6 years

APPENDIX B

TECHNICAL NOTES—COMPUTER SIMULATION: THE EFFECT OF CONSERVATION MEASURES ON UTILITY LOAD FACTORS AND COSTS

The Question

Will widespread adoption by residential electric customers of conservation measures, particularly insulation, result in utility load changes that are economically counterproductive to the utilities and/or their customers?

Background

Many residential consumers of electricity are investing in energy-saving materials and devices for their homes in hopes of reducing their utility bills, or at least stemming the rapid increases they have experienced recently. Adding insulation to existing homes is the action most commonly taken, but some homeowners—and builders of new homes—are also choosing HVAC systems with energy efficiency and cost savings in mind. Electric heat pumps are becoming widely used for this reason. Consumer attitudinal surveys indicate that electric customers investing in conservation measures are motivated primarily by the hope of saving money.

Whether or not consumers experience lower or even slower growing utility bills in the future depends ultimately on whether or not their utility companies can achieve cost savings that can be passed on, in turn, to ratepayers. Many factors affect utility costs, and consumer conservation actions will not be the only determinant of the direction in which rates will go in the next few years. But utility managers have raised questions about the possibility that conservation practices could have some adverse effect on load factors and systemwide costs, thereby contributing to a need for higher rates. From the consumer's standpoint, this would surely be the ultimate example of "Catch-22."

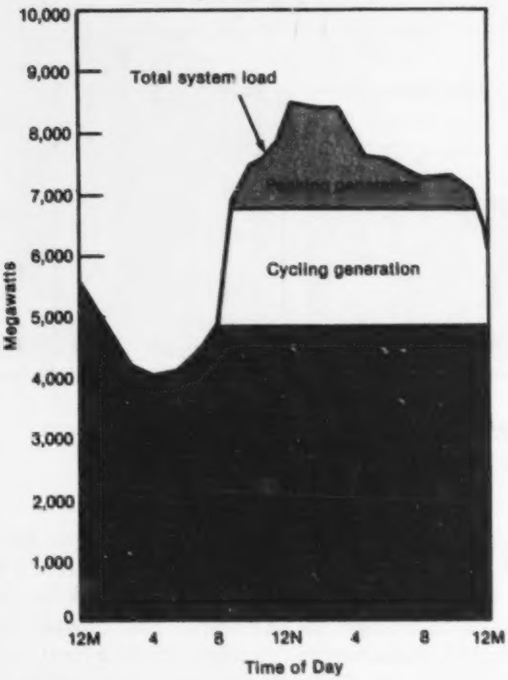
The fear of cost increases caused by conservation actions is based on the fact that utility costs are positively correlated to seasonal and daily variations in the demand for electricity, and on the possibility that insulation and other conservation measures could magnify these variations in uneconomic ways. Electric companies must have available to them at any given time enough generating capacity to meet the highest level of demand expected at that time, plus a reserve margin of capacity to use in the event that some powerplants are shutdown by emergencies or for routine maintenance. But since the peak demand level may be reached on only a few days each year, and for only a few hours even on those days, utilities are likely to have a considerable fraction of their total generating capacity idle much of the time.

Idle generating capacity is expensive, and certain kinds of powerplants are more expensive to keep idle than others. Although a company pays for fuel and other operating costs only when the plant is operating, many fixed costs—such as interest on the capital borrowed to build the plant—must be paid regardless of how much the plant is used. It follows, then, that newer, bigger, more capital-intensive plants (particularly nuclear plants) are the most expensive to shutdown, while older, smaller plants (like oil-fired turbines) are the least expensive to hold in reserve. Conversely, new plants are often the least expensive to operate, while the older ones (which usually use the most expensive fuels) are the most costly to run.

A utility's daily or yearly "load"—the total amount of electricity it must generate during that time—is usually thought of as having three components. The baseload—that which is demanded nearly all the time—is the largest component and is usually generated with the company's newest, largest, and most technologically advanced plants. The intermediate load—an increment that is demanded less of the time—is typically derived from slightly older and smaller plants, fired with fossil fuels.

The peakload—a sharply greater demand component that may be demanded only occasionally—is usually met with small oil- or gas- fired turbines, or with pumped-storage hydroelectric plants, or by purchasing power from other companies sharing the same distribution grid. Figures 18 and 19 illustrate a typical system load and the three major generating components.

Figure 18.—Dispatching Generation to Meet a Cyclical Load

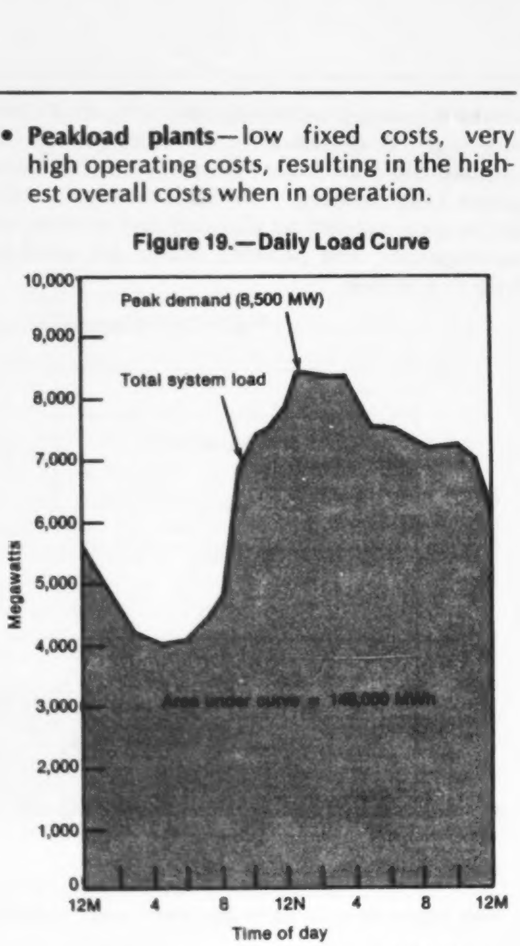


SOURCE: Electric Utility Rate Design Study, *Rate Design and Load Control: Issues and Directions*, a Report to the National Association of Regulatory Utility Commissioners, November 1977.

The costs of keeping and operating these different kinds of plants vary, typically, as follows:

- **Baseload plants**—high fixed costs, low operating costs, resulting in the lowest overall costs when in operation.
- **Intermediate-load plants**—medium fixed costs, medium-to-high operating costs, resulting in medium overall costs when in operation.
- **Peakload plants**—low fixed costs, very high operating costs, resulting in the highest overall costs when in operation.

Figure 19.—Daily Load Curve



$$\text{Daily load factor} = \frac{\text{daily energy}}{\text{24 hr} \times \text{peakload}} = \frac{\text{149,000 MWh}}{\text{24 hr} \times \text{8,500 MW}}$$

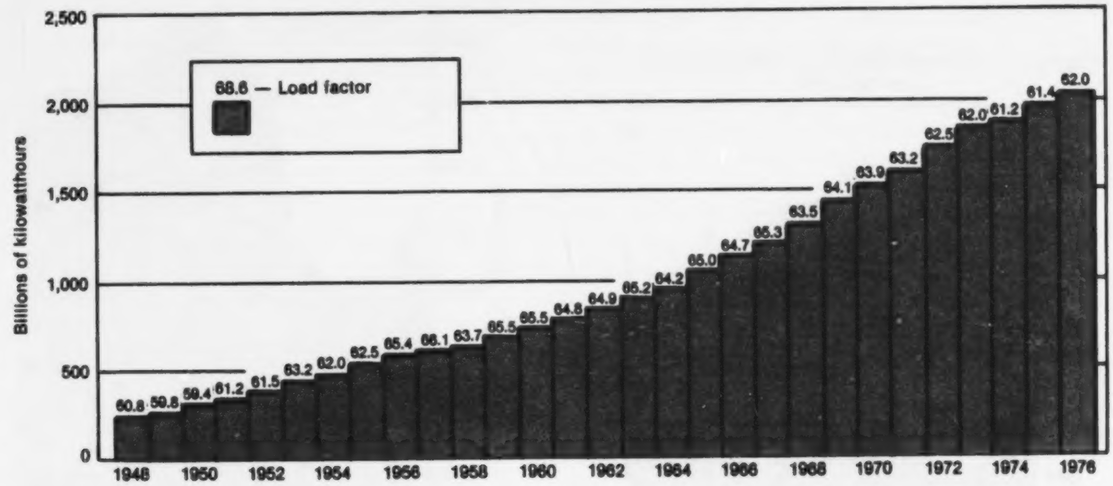
$$= 0.73 = 73\%$$

SOURCE: Electric Utility Rate Design Study, *Rate Design and Load Control: Issues and Directions*, a Report to the National Association of Regulatory Utility Commissioners, November 1977.

A major determinant of total utility costs and generating capacity needs is a company's "annual load factor," which is the ratio of the average utility load over the year to the peakload during any time period (usually 15 minutes) during the year. The higher the load factor, the less total downtime the company experiences in its generating capacity. Up to a certain point, the utility benefits from keeping its plants running, generating sales revenues with which to cover both fixed costs and operating costs. Some idle capacity is needed, however, to allow normal maintenance operations to take place, to substitute for other plants in emergency outages, and to meet the peaks. When all plants are operating and additional power is being purchased, operating costs are very high. It is desirable, in other words, to balance the load factor properly so that base plants keep running, intermediate plants take up the gaps caused by planned and unplanned interruptions, and peaking plants are used as little as possible.

A typical load factor, and one which accomplishes this goal reasonably well, is in the neighborhood of 0.65, or an average use of 65 percent of capacity. Figure 20 shows average annual load factors and total electricity output for U.S. utilities between 1948 and 1976.

Figure 20.—Electric Energy Output and Annual Load Factors



SOURCE: Electric Utility Rate Design Study.

Note: Figures shown are for the total electric utility industry of the contiguous United States.

OTA Analysis of Conservation Impact on Utility Loads and Costs

A model developed for OTA's recent study, *Application of Solar Energy to Today's Energy Needs,* analyzed the impact of conservation measures on utility operations.

OTA's model simulates utilities in four U.S. cities. The utility loads, shown in table 60, consist of a mix of single-family homes, townhouses, low- and high-rise apartments, shopping centers, industry, and streetlighting. Each of the four cities has the same number of units although the heating and cooling loads are determined by the weather conditions, taken from 1962 data, of each city. The residential heating and cooling equipment mix is initially set to match conditions in 1975 and then forecast to 1985 using a residential energy use model developed by ORNL. All the single-family homes are initially set to the same level of insulation, which the model can increase to a higher value. The insulation levels in the other buildings do not vary. The change for single-family homes corresponds to a heat load reduction of 31 to 49 percent, depending on the location. In addition to the insulation level, the type of heating equipment can be changed to allow the possibility of varying the percentage of homes that are electrically heated. Diversity is built into the model so that the peakloads of the individual homes do not all occur simultaneously.[35]

To determine the effects on utility loads of increased insulation among residential

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[35] Further details about the model and the hypothetical utility loads can be found in *Application of Solar Energy to Today's Energy Needs*, vol. I, chapter V, and vol. II, chapter VI.

Table 60.—1985 Projection of Heating Unit Mix and Basic Loads (number of buildings)

	Albuquerque	Boston	Fort Worth	Omaha
Single family units				
Electric heat	10,470	8,080	11,790	7,720
Fossil heat	45,450	47,840	44,130	48,200
Electric cooling	43,613	34,863	55,920	55,920
Total	55,920	55,920	55,920	55,920
Townhouses	6,960	6,960	6,960	6,960
Low rise units	2,160	2,160	2,160	2,160
High rise units	600	600	600	600
Shopping centers	30	30	30	30

Annual industrial loads (all cities)—2.54 billion kWh.
Annual streetlight load (all cities)—98.78 million kWh.

customers, the model was run first with all single-family homes at the baseline insulation level and again at the high insulation level, using the forecast 1985 mix of home heating systems initially, and then using an assumption that 50 percent of the homes were electrically heated. (The latter case was included to simulate utilities with winter peaks.) All other load characteristics remained constant throughout the analysis. The heating and cooling mix for single-family homes for the 1985 forecast is shown in table 60. Table 61 shows the numbering of buildings assumed to have electric heat in the case when it was assumed that 50 percent of residences use electric heat.

Results

The load factor and seasonal peak demands are given in table 62 for the reference and the high insulation cases for both mixes of residential heating—1985 projection and high electric resistance. *The results show that an increase in insulation does not change the load factor significantly.* In all but two situations, the load factor increases as insulation is added, but the increase does not exceed 4 percent. The two exceptions are the utilities with 50-percent electric resistance heat that still experience their peakloads in the summer.

Table 61.—50-Percent Electric Resistance Heating by 1985 (number of buildings)

City	Electric heat	Fossil heat	Total
Albuquerque, Boston, Fort Worth, and Omaha	27,960	27,960	55,920

Table 62.—Simulated Utilities' Load Factors, Peaks, Summer-Winter Ratio by 1985

	Albuquerque		Boston		Fort Worth		Omaha	
	Reference case	High insulation	Reference case	High insulation	Reference case	High insulation	Reference case	High insulation
Base case								
Load factor	0.534	0.537	0.498	0.505	0.470	0.475	0.448	0.453
Winter peak (MW,	1,359	1,315	1,316	1,263	1,562	1,472	1,453	1,397
month)	Jan.	Jan.	Feb.	Feb.	Jan.	Feb.	Feb.	Feb.
Summer peak (MW,	1,386	1,352	1,354	1,320	1,942	1,873	1,823	1,768
month)	Aug.	Aug.	Jul.	Jul.	Aug.	Aug.	Jul.	Jul.
Summer-winter ratio	1.02	1.03	1.03	1.05	1.24	1.27	1.25	1.26
50-percent electric resistance heating case								
Load factor	0.472	0.485	0.466	0.492	0.483	0.481	0.483	0.467
Winter peak (MW,	1,677	1,569	1,600	1,433	1,842	1,594	1,787	1,603
month)	Jan.	Jan.	Feb.	Feb.	Jan.	Jan.	Feb.	Feb
Summer peak (MW,	1,368	1,348	1,392	1,362	1,958	1893	1,847	1,805
month)	Aug.	Aug.	Jul.	Jul.	Aug.	Aug.		
Summer-winter ratio	0.79	0.86	0.87	0.95	1.06	1.19	1.03	1.13
50-percent heat pump case								
Load factor	0.465	0.484	0.446	0.483	0.470	0.476	0.463	0.457
Winter peak (MW,	1,632	1,528	1,587	1,426	1,778	1,569	1,787	1,599
month)	Jan.	Jan.	Feb.	Feb.	Jan.	Jan.	Feb.	Feb.
Summer peak (MW,	1,373	1,351	1,400	1,368	1,976	1,906	1,861	1,815
month)	Aug.	Aug.	Jul.	Jul.	Aug.	Aug.	Jul.	Jul.
Summer-winter ratio	0.85	0.88	0.88	0.96	1.11	1.21	1.04	1.14

The effect on the summer-winter peak difference, shown in table 62, is more pronounced. For all summer peaking utilities, for either mix of heating systems, the ratio of the summer to winter peak increases as a result of increased insulation. These increases range from 1 to 12 percent and are greatest for the utilities with the highest percentage of electric heat. For the winter peaking utilities, the ratio decreases by about 8 percent when the residential insulation level is increased.

Discussion

These simulations indicate that the effect of extensive additions of insulation by residential customers depends greatly on the amount of residential electric heat in the utility's load, since adding insulation affects heating loads more than cooling loads. Utilities that have winter peaks or small electric heat loads (relative to their cooling loads) experienced increases in their load factors; this means that their peakloads were reduced more than their average loads by the addition of insulation. On the other hand, two of the simulated utilities—those with summer peaks accompanied by large electric heating loads—experienced moderate drops in their load factors after insulation was added. Summer-winter peak ratios change very little—under 2 percent—in the cases for which the electric heating load is small, but as that load increases, the change in the ratio also grows until the winter peak begins to exceed the summer peak.

In sum, OTA's simulation indicates that most utilities will not be measurably affected by the widespread addition of insulation by residential customers, unless at least a third or so of their residential customers use electric heat. If more than half use electric heat, the utility will still experience an improved load factor as long as its peak comes in the winter. In such cases, the increase in load factor and the leveling of differences between summer and winter peaks can assist in bringing about more efficient use of generating capacity.

APPENDIX C

Job Description

PROPOSED ENERGY AUDIT TECHNICIAN

Nature of Work

This is semi-technical work in the handling of customer energy audits and information relating to all utility services.

An employee of this class performs energy audits and is knowledgeable in energy conservation measures. Through personal contact with the customers this employee will promote better public understanding and acceptance of Utility policies. Work is reviewed by supervisor through analysis of reports, conferences, and observation of results obtained.

Illustrative Examples of Work

Makes personal contact with customers regarding energy audits and high bill complaints.

Keeps abreast of new developments in energy conservation issues and measures; reads and keeps current records on all test meter installations. Keeps reports and makes recommendations on energy audits.

Installs test meters on household appliances to aid in explanation of electrical consumption.

Performs related work as required.

Desirable Education and Experience

Completion of two years of college or one year of experience in a Utility educational program, or any other equivalent combination of training and/or experience.

Knowledge of the principle use of electricity in the home and of the use and care of standard appliances.

Knowledge of energy conservation measures.

Some knowledge of the normal functions of an electric utility.

Some knowledge of the principles and practices of customer relations.

Ability to express oneself clearly both orally and in writing.

Ability to establish and maintain effective working relationships with associates, utility customers, and the general public.

Job Description

PROPOSED ENERGY COUNSELOR I

Nature of Work

This is specialized work in assisting customers with utility problems and better utilization of services.

An employee of this class examines customer problems and advises his supervisor as to troubled areas of Utility-customer relationships. Work also involves emphasis on better utilization and conservation of Utility services. Work is reviewed by supervisor through analysis of reports, conferences, and observation of results obtained.

Illustrative Examples of Work

On the telephone or in person, advises users on effective utilization of appliances and conservation of energy; assists customers in settling complaints about services and charges which could not be handled by the telephone center.

Provides advice on appliances.

Works with Energy Counselor II in preparing and delivering presentations on energy conservation and related matters; prepares color slides and other visual aids.

Attends seminars and short courses relating to Utility services and energy conservation.

Performs related work as required.

Desirable Education and Experience

Graduation from an accredited four-year college or university with major course work in journalism, public relations, or Home Economics and one year of public relations experience, preferably in a public utility; or any equivalent combination of education and experience which provides the following knowledge, abilities, and skills:

- Knowledge of public relations principles and practices.
- Knowledge of Utility operations and services in the billing and collection areas.
- Ability to prepare effective presentations and deliver them before community groups.
- Ability to express oneself effectively, orally and in writing.
- Ability to conceptualize, organize, and carry out public and customer relations programs.
- Ability to relate effectively to utility customers and create a good image of the Utility and its services.

Job Description

PROPOSED ENERGY COUNSELOR II

Nature of Work

This is the professional level work in consumer information and education.

An employee of this class assists in resolving complaints of more technical nature through personal contact with consumers in the field. Duties include assisting the Energy Counselor I and Energy Audit Technicians in more difficult problems in their respective areas. Emphasis of this position is on effective consumer and employee education with different Utility divisions in problem solving and consumer activities. Work is reviewed by supervisor through analysis of reports, conferences, and observation of results obtained.

Illustrative Examples of Work

Assuming responsibility and duties of Energy Counselor I and Energy Technician when work load dictates.

Offers planning and layout assistance in efficient appliances and lighting layouts.

Prepares and presents talks and demonstrations to community groups, schools, and organizations.

Helps write, prepare, and coordinate informational programs to the public in the form of information pamphlets, booklets, slide presentations, and exhibits.

Participates in APPA and FMUA programs as required.

Performs related work as required.

Desirable Education and Experience

Graduation from an accredited four-year college or university with major course work in business administration, marketing, journalism, home economics; and three years of experience in Utility work; or any equivalent combination of education and experience which provides the following knowledge, abilities, and skills:

- Thorough knowledge of the working of an electric utility with emphasis on updating this knowledge continuously.
- Considerable knowledge of policies, procedures, and practices of the department.
- Considerable knowledge of energy conservation and public relations techniques.
- Working knowledge of modern office management and procedures including budget and customer relations.
- Thorough working knowledge of the functions of the various divisions of the Utilities Department.
- Working knowledge of techniques used by other Utilities.
- Knowledge of the APPA and FMUA associations and their respective functions.
- Ability to use figures and to perform basic computations.
- Ability to express oneself clearly and concisely, orally and in writing.
- Ability to present and promote the image of the City and the Utilities Department to the general public.
- Ability to establish and maintain effective working relationships with associates, supervisory personnel, as well as customers.

Job Description

PROPOSED ENERGY INFORMATION COORDINATOR

Nature of Work

This is administrative work coordinating and directing all activities of the Energy Information Department.

An employee in this class is responsible for administering the activites of all employees in the Energy Information Office. The duties include handling problems and requests of a more technical nature than would be normally assigned to other employees. The work entails office duties, assignments of duties of subordinates, employee training, and so on. This employee makes certain that all energy audits and programs are executed and followed up properly, is responsible for news releases and working with the media, and handling special arrangements and activites. Work is evaluated through conferences, review of reports, and observation of results obtained.

Illustrative Examples of Work

Keeps the Division employees informed regarding developments made in utilities, i.e. rate changes, technological developments, techniques, conservation measures, etc., which pertain to the City and competing utilities.

Plans, assigns, and schedules the work of subordinates. Compiles procedural manuals for the department.

Handles training classes for city employees in the basic techniques regarding energy conservation and information concerning utilities.

Initiates requisitions for materials and supplies for the Division; prepares and administers Division's budget.

Speaks to local civic groups and other organizations as a representative of the Utilities department and takes active part as time allows.

Makes complete plans for commercial and industrial lighting installations.

Responsible for the operation of the speaker's bureau.

Performs related work as required.

Desirable Education and Experience

Graduation from an accredited four-year college or university with major course work in advertising, marketing, public relations, or business administration; and five years of experience in utility consumer service functions preferably with a municipal utility; or any equivalent combination of education and experience which provides the following knowledge, abilities, and skills:

- Thorough knowledge of the everyday functioning of an electric utility.
- Thorough knowledge of policies, procedures, and practices of the Utilities division.
- Considerable knowledge of modern office management and procedures including budget, payroll, and personnel administration.
- Considerable knowledge of the functions of the various divisions of the City.
- Considerable knowledge of techniques used by other utilities to promote energy conservation.
- Ability to plan, organize, and supervise clerical, professional, and office operation procedures.
- Ability to present and promote the image of the City and the Utilities Department to the general public.
- Ability to establish and maintain effective working relationships with associates, subordinates, and potential customers as well as established customers.

Job Description

ENERGY UTILIZATION SURVEYOR

System: Customer Services

Department:

Division: Consumer Information

Section: Energy Survey

Unit:

Responsible to:

Purpose

Assess the energy efficiency of residences and recommend retrofittings and other means to enhance energy efficiency.

Duties and Responsibilities

By appointment, meets customers in their homes to perform energy efficiency surveys.

Determines efficiency rating (R-Value) of existing insulation and recommends additional or supplemental insulation as needed.

Determines the effectiveness of other types of weatherization such as storm windows/doors, caulking, water heater insulation, weatherstripping, underpinning. Recommends needed improvements.

Calculates estimated cost of all suggested retrofittings or improvements.

Takes an inventory of other factors affecting energy consumption, i.e. appliances, a/c-heating units, thermostat settings, family energy habits, etc. Refers customer inquiries about these items to appropriate area in Consumer Information.

Supervision

None supervised. Generally follows established procedures. Exercises judgment in determining efficiency of current conditions. Refers unusual or difficult situations to supervisor.

Specifications

One to two years technical training preferred. May be acquired through formal education, or by experience in any of the building trades. Must satisfactorily complete a 90-day in-house training program. Must possess a valid driver's license.

Personal

- Mechanical aptitude
- Demonstrable oral communication skills
- Neat appearance
- Pleasing personality

Working Conditions

Normal office, customers' homes (including attics, sometimes roofs). Exposure to some hazards, i.e. energized circuits of normal house voltage, climbing up and down ladders. Subject to traffic hazards.

Usual Lines of Promotion

From:

To:

APPENDIX D

ESTIMATED BUDGET

1. Personnel Services

Home Energy Consultant	$ 10,760
Clerical Support (520 hours)	3,240
	$ 14,000 Maximum

2. Start-up Costs[1]

Programming to set up billing	$ 1,500
Materials	3,200
Postage	50
Drafting	250
Miscellaneous (phone line, travel)	1,000
	$ 6,000

---

[1] These figures are an estimate only. As expenditures are made for start-up costs, the figures may change. To be reimburseable, all changes to the above budget must receive prior written approval of the contract managers.

1978-79 PROPOSED BUDGET FOR THE CONSUMER SERVICE DEPARTMENT

Personnel Service

1 Supervisor	Pay grade 44		
2 Representatives II	Pay grade 38		
1 Representative I	Pay grade 30		
3 Technicians	Pay grade 18		
1 Secretary II	Pay grade 14		
		Total	$96,013.00
		w/o Supervisor	77,064.00

ACTIVITIES

Presentations

Energy Today & Tomorrow	$ 2,000.00
Display Module for Exhibits	500.00
Energy Information Center for City Hall	500.00
	$ 3,000.00

Materials & Supplies

3 "Heat-Loss" Calculators @ $200	$ 600.00
Conservation Crew Field Equipment	1,000.00
5000 Energy Conservation Badges	800.00
5000 Energy Conservation Comic Books @ 35¢	1,750.00
Temperature Range Gun	850.00
	$ 5,000.00

Postage

2000 letters @ 13¢	$ 260.00
500 packets (as requested) @ 50¢	250.00
	$ 510.00

Training

Energy Conservation Workshop	$ 600.00
APPA Courses (FMUA)	1,500.00
Kodak Basic Audio Visual Course	70.00
Nikon Camera Course	30.00
Insulation Courses	500.00
Air Conditioning Short Course	300.00
State Energy Office Seminars	300.00
Meter Course	90.00
National Association of Home Builders	300.00
Other Related Seminars	310.00
	$ 4,000.00

Travel	
Energy Conservation Workshop	$ 1,500.00
APPA Courses	2,000.00
Air Conditioning Short Course	200.00
Insulation Courses	500.00
State Energy Office Seminars and Meetings	500.00
Meter Course	100.00
National Association of Home Builders	500.00
Miscellaneous Travel for Meetings in State	700.00
	$ 6,000.00
Dues, Membership, Publications	
Trade Associations	$ 200.00
Kiplinger Letters	64.00
Solar Age	40.00
Electric Letter	39.00
Air Conditioning News	30.00
Inside DOE	210.00
Public Relations Society of America	217.00
	$ 800.00
Maintenance of Equipment	$ 200.00
Office Supplies and Printing	
Photographic Supplies & Printing	$ 1,800.00
Dissolving Sinc Machine	850.00
Typewriter	700.00
Desks & Chairs (3 of each)	370.00
3 Calculators	450.00
Miscellaneous Office Supplies & Rate Schedules	830.00
	$ 5,000.00
Professional Service (Printing)	
Pamphlets & Brochures:	
1. How to Caulk & Weatherstrip Pamphlet	$ 290.00
2. Conservation Reminder Stickers	280.00
3. "How To" Booklet	4,270.00
4. Conservation Folder	1,400.00
5. Energy Conservation Information Catalog with examples	2,000.00
6. "Electric Budget" Folders	1,000.00
	$ 9,240.00

TOTALS

Personnel Service	$ 96,013.00
Other Activites	33,750.00
Sub-Total	$129,763.00
Thermographic Fly-over	22,560.00
Five (5) Vehicles	25,000.00
TOTAL	$177,323.00

NOTE: The above budget does not include costs for advertising or office space.

APPENDIX E

YES YOU CAN SAVE ENERGY SAVE MONEY

Energy Management Division
Gainesville Regional Utilities
P. O. Box 490
Gainesville, FL. 32602

ENERGY e^2 EFFICIENCY

REGIONAL UTILITIES

HOME ENERGY SURVEY

Customer Name ________________________________ Phone ______________

Address ____________________________________ Date of audit ________

Account Number ____-________-____ Time ______________

1. How many people are in your family? ________

2. How long do you plan to live in this home? ________

3. Please consider your families use of the following appliances. Indicate in the blank the number of hours per week each appliance is used.
   ________ Roaster
   ________ Deep Fryer
   ________ Rotisserie
   ________ Broiler Oven
   ________ Electric Fry Pan
   ________ Coffee Maker
   ________ Automatic Clothes Washer
   ________ Conventional Clothes Washer (Wringer Type)
   ________ Electric Clothes Dryer
   ________ Iron
   ________ Attic Fan (Whole house ventilation)
   ________ Circulating Fan (Oscillating or floor type)
   ________ Ventilation Fan (Window fan or kitchen exhaust type)
   ________ Heater, 550-watt (Portable)
   ________ Heater, 1,350-watt (Portable)
   ________ Color TV
   ________ Black & White TV
   ________ Radio
   ________ Stereo
   ________ Dishwasher
   ________ Water Pump (Irrigation pump, Pool pump)

4. How many hot water clothes washes do you do each week? ________

5. During the winter, at what temperature do you normally set the heater thermostat? ______°F

6. During the summer, at what temperature do you normally set the air conditioner thermostat? ________°F

7. During the work week, is your home occupied during the day? (1) all year (2) summer only (3) after school and during the summer (4) only for short periods (holidays) (5) other ____

8. When no one is home, is the thermostat set 5 or more degrees higher in the summer and 5 or more degrees lower in the winter? ________

Page 2 - HOME ENERGY SURVEY QUESTIONNAIRE

9. Indicate, in the blank, how many of each appliance you use.

________ Sandwich Grill
________ Toaster
________ Refrigerator - 12 cubic feet, manual defrost
________ Refrigerator/Freezer* - 12 cubic feet, manual defrost
________ Refrigerator/Freezer - 12 cubic feet, frost-free
________ Refrigerator/Freezer - 15 cubic feet, frost-free
________ Refrigerator/Freezer - 18 cubic feet, frost-free
________ Refrigerator/Freezer - 21 cubic feet, frost-free
________ Refrigerator/Freezer - 24 cubic feet, frost-free
________ Refrigerator/Freezer - 24 cubic feet, frost-free, 3-door
________ Freezer - 12 cubic feet, manual defrost
________ Freezer - 16 cubic feet, manual defrost
________ Freezer - 12 cubic feet, frost-free
________ Freezer - 16 cubic feet, frost-free
________ Lighting - up to 5 rooms
________ Lighting - 6-8 rooms
________ Lighting - 9 or more rooms
________ Electric Blanket
________ Dehumidifier
________ Trash Compactor
________ Vacuum Cleaner
________ Clock
________ Heating Pad
________ Warming Tray
________ Electric Tooth Brush
________ Waffle Iron
________ Hair Dryer
________ Heat Lamp
________ Workshop Equipment*
________ Garbage Disposal
________ Sewing Machine
________ Floor Polisher
________ Bottle Warmer
________ Ice Cream Freezer
________ Food Mixer
________ Blender
________ Carving Knife
________ Electric Hot Plate

Please give us the total light bulb wattage in your home.

____

* Note 1: The size of refrigerators and freezers is usually listed on an information sticker affixed either on the face of the area where the door seals (seen when open) or inside the refrigerator compartment located on a side by the vegetable storage bin. If not marked the RUB surveyor will measure it.

* Note 2: If you use any workshop equipment, just enter a "1" in the appropriate blank.

10. List any electric appliance or large power consuming workshop equipment you use but is not listed above. If possible, list the wattage.

Number	Appliance	Wattage

YES YOU CAN SAVE ENERGY SAVE MONEY

HOME ENERGY ANALYSIS
QUESTIONNAIRE

ENERGY e2 EFFICIENCY

Name ______________________________ Phone ______________

Address ____

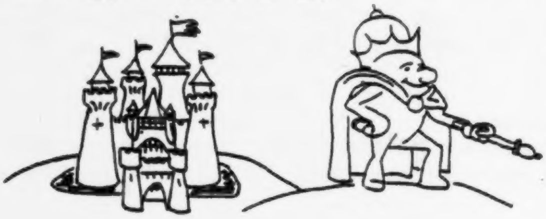
Account No. ____________________ Auditors ______________

1) Place test thermometer on thermostat.

_____°F Thermostat setting
_____°F Thermostat thermometer reading.

2) Review and complete customer's questionnaire.

3) What type of home is it?



1_____ 1-story flat roof
2_____ 2-story flat roof
3_____ Split-level flat roof
4_____ Split-level pitched roof
5_____ More than 2-story flat roof
6_____ More than 2-story pitched roof
7_____ 1-story pitched roof
8_____ 2-story pitched roof
9_____ Other (Describe) ______________
____

4) When was the nome built?

_____ Before 1945
_____ 1945-1955
_____ 1956-1965
_____ 1966-1970
_____ 1971-1975
_____ After 1975

5) What is the color of the majority of the exterior walls?

_____ Light (White, grey or pastels)
_____ Medium (Beige, tan)
_____ Dark (Dark red, brown, green or black)

6) If the home has a pitched roof, what color is the roof (Leave blank if it's a flat roof.)?

_____ Light (White, grey or pastels)
_____ Medium (Beige, tan)
_____ Dark (Dark red, brown, green or black)

7) What direction does the front of the home most nearly face?

_____ North (0°)
_____ East (90°)
_____ South (180°)
_____ West (270°)
_____ NE (45°)
_____ SE (135°)
_____ SW (225°)
_____ NW (315°)

8) What covers most of the surface of the ground in the front and back of your home.

_____ Grass or other vegetation
_____ Sand, cement, gravel or other light colored material
_____ Asphalt, bare soil, or other dark colored material

Appliance Survey

9) Refrigerator (refrigerator/freezer)
Size ________cu. ft.

Location Good ___ Poor ___
Frost-free Yes ____ No _____
Is ice build-up over 1/4 inch? Yes ____ No _____
Door seals Good ___ Poor ___
Coils Clean___ Dirty___
Over-all visual condition Good ___ Poor ___

10) Freezer:
Size_________cu. ft.
Upright _____Chest _____

Location Good ___ Poor ___
Frost-free Yes ____ No _____
Is ice build-up over 1/4 inch? Yes ____ No _____
Door seals Good___ Poor ___
Coils Clean___ Dirty___
Over-all visual condition Good ___ Poor ___

11) Range (or range/oven combination)
Electric ____ Gas _____
Wood _____ Other ______

Hours spent cooking
per month _________

Location Good ___ Poor ___
Over-all visual condition Good ___ Poor ___
Do pans fit elements Yes ____ No _____
Does gas flame fit pans Yes ____ No _____
Are lids used when possible Yes ____ No _____

12) Oven (when separate from range)
Electric ____ Gas ____
Other ________________
Hours used ___________

Location Good ___ Poor ___
Over-all visual condition Good ___ Poor ___
Does customer pre-heat? Yes ____ No _____

13) Is there an outside exhaust fan over range? Yes _______ No _______
Is there an outside exhaust fan over oven? Yes _______ No _______

14) Microwave oven
Does the customer have one? Yes _______ No _______
How many hours per month is it used? __________

15) Dishwasher
(Does not have one. ____)
Overall visual condition? Good ______ Poor_______
Are all loads full loads? Yes _______ No ________
Can the dry cycle be avoided automatically Yes _______ No ________
Can the dry cycle be avoided manually? Yes _______ No ________

16) Clothes Washer
Automatic ____ Conventional _____ (Does not have one_____)
Condition: Good _____ Poor _____
Location: In conditioned space _____ Outside conditioned space _____
Is hot water used in most loads? Yes _____ No _____
Can cold water be used more often? Yes _____ No _____
Are most loads full loads? Yes _____ No _____

17) Dryer
Electric _____ Gas _____ (Does not have one._____)
Condition: Good _____ Poor _____
Location: In conditioned space _____ Outside conditioned space _____
Is it vented to outside? Yes _____ No _____

Energy Audit
Page Three

18) Water Heater
Size _____ gallons

_____ Electric
_____ Gas
_____ Oil
_____ Wood
_____ Solar
_____________________ Other

Does it have an insulation jacket on it? Yes _____ No _____
Location: Inside conditioned space? Yes _____ No _____
At what temperature is is set _______°F Don't Know _____
Does the "feel test" indicate a possible leak? Yes _____ No _____
Have you noticed any leaking faucets? Yes _____ No _____
If yes, were they hot water faucets? Yes _____ No _____

19) Heating
Size __________ BTU's

_____ Heat pump
_____ Natural Gas
_____ LP Gas
_____ Electric
_____ Fuel Oil
_____ Solar
_____ Wood
_____________________ Other

20) Air-Conditioning: Make______________
Model___________BTU's______________
(If more than one unit list each unit separately in open space. Include power information.)

_____ Window Units
_____ Central
_____ Electric
_____ Gas
_____ Volts
_____ Amps

Is outside unit clear and free from obstructions? Yes _____ No _____

a) During the cooling season, in what month is the air conditioner first turned on?
_____ April
_____ May
_____ June
_____________________ Other

b) During the cooling season, in what month is the air conditioner last used?
_____ August
_____ September
_____ October
_____________________ Other

Thermostat location: _____ Inside wall _____ Outside Wall

Thermostat test:
_____°F Thermostat setting now
_____°F Thermostat thermometer reading
_____°F Test thermometer reading

21) Ventilation (or air handling)
a) Air-conditioning/heating
Is there a duct system? Yes _____ No _____
Are ducts insulated? Yes _____ No _____
Are output and return air grills clear of obstructions? Yes _____ No _____
Are filters: _____ Clean _____ Dirty
How often changed? _____________________

b) Mechanical Ventilation
_____ Circulating fan(s)
_____ Ceiling fan (s)
_____ Window Fan
_____ Whole House Fan
_____ None

c) Attic Ventilation

_____ Eves
_____ Gable Vents
_____ Wind Turbines
_____ Limited length roof vents
_____ Ridge Vents
_____ Power Roof Ventilator
_____ None

22) What is the total light bulb wattage of the home? __________

23) What type of construction best describes the exterior walls?

1_____ Wood frame with stucco
2_____ Wood frame with brick veneer
3_____ Wood frame with siding
4_____ Concrete, stone or slump block
5_____ Brick
6_____ Cinder block or hollow clay tile
7_____ Log
8_____ Adobe
9_____ Other (describe)____________________
____

24) What type of floor is in the home? (If there is more than one floor type, place an "A" next to the type that describes most of the home. Place a "B" next to the type that describes the rest of the home.

_____Concrete slab on the ground
_____Concrete floor over crawl space
_____Wood floor over crawl space
_____Wood floor over concrete basement
_____Brick
_____Other (describe) ____________________
____

25) Approximately how much insulation is in the walls? (If the R value of the insulation is known, indicate below and skip to question No. 27.)

R = __________

1_____ 1"-1 1/2"
2_____ 2"-2 1/2"
3_____ 3"-3 1/2"
4_____ 4"-4 1/2"
5_____ 5"-5 1/2"
6_____ 6"-6 1/2"
7_____ None
8_____ Don't know

26) What does the insulation look like?

_____ Blankets or batts
_____ Loose particles
_____ Foam
_____ Rigid board
_____ None present
_____ Don't know

27) Approximately how much insulation is in the ceiling?

11_____ 1"-1 1/2"
12_____ 2"-2 1/2"
13_____ 3"-3 1/2"
14_____ 4"-4 1/2"
15_____ 5"-5 1/2"
16_____ 6"-6 1/2"
17_____ 7"-7 1/2"
18_____ More than 7 1/2"
19_____ None
20_____ Don't know

28) What does the insulation look like?

_____ Blankets or batts
_____ Loose particles
_____ Foam
_____ Rigid board
_____ None present
_____ Don't know

29) Is the insulation of uniform thickness throughout the attic? Yes _____ No _____

30) Do you usually open or remove shades on sunny winter days? Yes _____ No _____

31) Do you usually close or install shading at night in the winter? Yes _____ No _____

32) Do you usually close or install shading on sunny summer days? Yes _____ No _____

33) How many fireplaces are in the home? __________

34) During the winter, how often do you build a fire on the average?

_____ Rarely or never
_____ About twice a month
_____ About once a week
_____ About three times a week
_____ Almost every night

35) How many of the fireplaces are equipped with heat recovery devices such as tube grates or "heatilators"? __________

36) How many of the fireplaces are equipped with glass doors? __________

37) How many of the fireplaces have a damper that closes tightly? __________

38) How many fireplaces are on exterior walls? __________

39) What is the approximate average height of the ceiling in the home (distance between floor and ceiling)? __________ feet

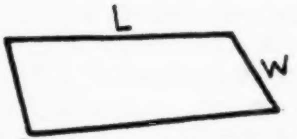
40) What is the total living area of the home? Include only the area that is heated. A simple method of determining the area is shown below. __________ square feet

PROCEDURES FOR CALCULATING AREA OF THE HOME

To get the total living area of your home, follow this procedure.

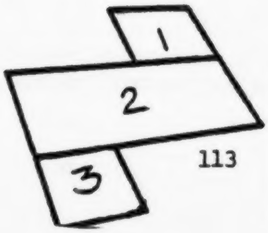
If your home is a rectangle:

Measure its length and width in feet to the nearest foot and multiply them together.

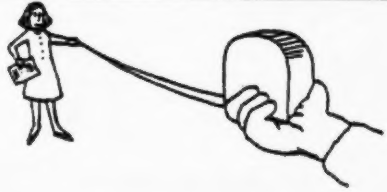


If it's a combination:

Break it down into rectangles, find the area of each one, then add the areas to get the total.



Leave out the garage unless it is heated.



length X width = area

______ X ______ = ______

length X width = area

1 ______ X ______ = ______
2 ______ X ______ = ______
3 ______ X ______ = ______

total area ______

WALL AND WINDOW INFORMATION

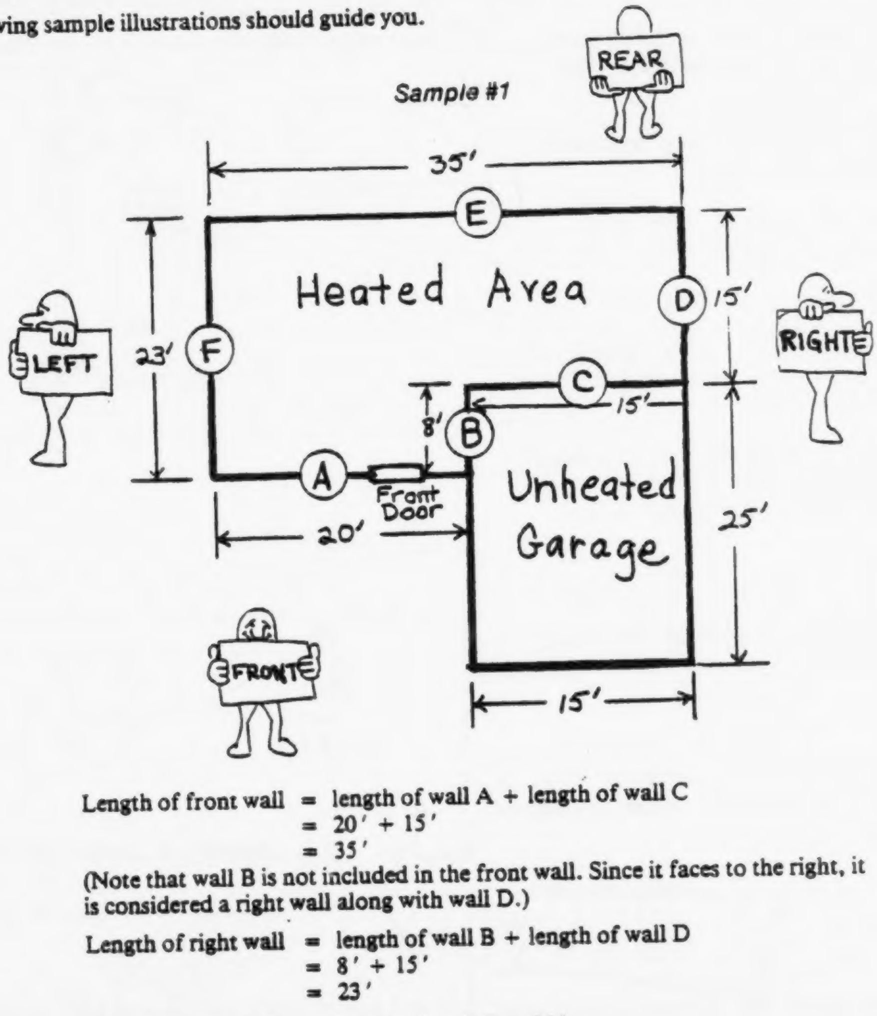
Instructions

In this section, you will need to measure the length of the outside walls and the size of the windows on each side of your home. Two things are important here:

1. Unless your garage is heated, pretend it isn't there. Treat the walls of the house that border on the garage as outside walls.
2. When describing any particular side of your home, describe only the walls and windows that actually face to that side.

The following sample illustrations should guide you.

Sample #1



Length of front wall = length of wall A + length of wall C
= 20' + 15'
= 35'

(Note that wall B is not included in the front wall. Since it faces to the right, it is considered a right wall along with wall D.)

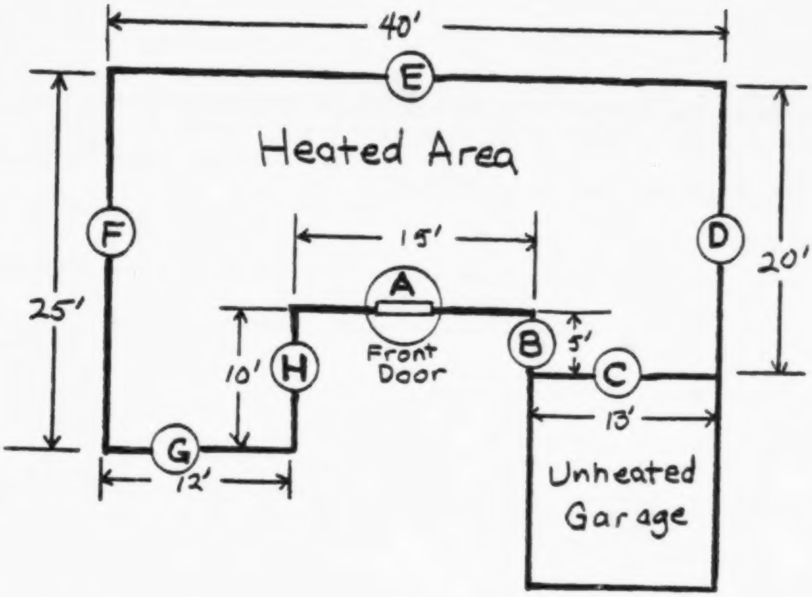
Length of right wall = length of wall B + length of wall D
= 8' + 15'
= 23'

Length of rear wall = length of wall E = 35'

Length of left wall = length of wall F = 23'

You can check your answers by noting that the length of the front wall equals the length of the rear wall. Also the length of the right wall equals the length of the left wall.

Sample #2



Length of front wall = length of wall G + length of wall A + length of wall C
= 12' + 15' + 13'
= 40'

(Note that wall H and wall B were not included in the front wall. Wall H faces to the right and is considered a right wall along with wall D. Wall B faces to the left and is considered a left wall along with wall F.)

Length of right wall = length of wall H + length of wall D
= 10' + 20'
= 30'

Length of rear wall = length of wall E = 40'

Length of left wall = length of wall F + length of wall B
= 25' + 5'
= 30'

You can check your answers by noting that the length of the front wall equals the length of the rear wall. Also the length of the right wall equals the length of the left wall.

WALL AND WINDOW INFORMATION

Front Side of House

Describe the front side of the house. Remember to include all outside walls and windows that face to the front. Treat sliding glass doors and French doors as windows.

41) __________ Overall length of front wall in feet.

Window #	1	2	3	4	5	6	7
42) Height (Feet)	______	______	______	______	______	______	______
43) Width (Feet)	______	______	______	______	______	______	______
44) How many layers of thicknesses of glass not counting storm windows? (1, 2, etc.)	______	______	______	______	______	______	______
45) Equipped with storm windows?	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No
46) Shaded by (check all that apply):	[Average width of eves___________]						
Trees	______	______	______	______	______	______	______
Awnings	______	______	______	______	______	______	______
Sun Screens	______	______	______	______	______	______	______
Tinting	______	______	______	______	______	______	______
Shades	______	______	______	______	______	______	______
Blinds	______	______	______	______	______	______	______
Drapes	______	______	______	______	______	______	______
Nothing	______	______	______	______	______	______	______
47) Needs Caulking Inside	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No
Outside	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No
48) Needs weatherstripping	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No

49) How many exterior doors? ________

50) Do any need weatherstripping? ______ Yes
______ No

51) Type: Solid Wood ______ Thin ______ Thick ______ Hollow core ______ Metal Insulated ______

52) Is there a house within 100 feet of the front side of your home? ______ Yes
______ No

WALL AND WINDOW INFORMATION

Rear side of House

Describe the rear side of the house. Remember to include all outside walls and windows that face to the rear. Treat sliding glass doors and French doors as windows.

41) ________ Overall length of rear wall in feet.

Window #	1	2	3	4	5	6	7
42) Height (Feet)	____	____	____	____	____	____	____
43) Width (Feet)	____	____	____	____	____	____	____
44) How many layers of thicknesses of glass not counting storm windows? (1, 2, etc.)	____	____	____	____	____	____	____
45) Equipped with storm windows?	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No
46) Shaded by (check all that apply): [Average Width of eves ________]							
Trees	____	____	____	____	____	____	____
Awnings	____	____	____	____	____	____	____
Sun Screens	____	____	____	____	____	____	____
Tinting	____	____	____	____	____	____	____
Shades	____	____	____	____	____	____	____
Blinds	____	____	____	____	____	____	____
Drapes	____	____	____	____	____	____	____
Nothing	____	____	____	____	____	____	____
47) Needs Caulking Inside	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No
Outside	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No
48) Needs weatherstripping	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No

49) How many exterior doors? ________

50) Do any need weatherstripping? ______ Yes
______ No

51) Type: Solid Wood ______ Thin ______ Thick ______ Hollow core ______ Metal Insulated ______

52) Is there a house within 100 feet of the rear side of your home? ______ Yes
______ No

WALL AND WINDOW INFORMATION

Right Side of House

Describe the right side of the house. Remember to include all outside walls and windows that face to the right. Treat sliding glass doors and French doors as windows.

41) ________ Overall length of right wall in feet.

Window #	1	2	3	4	5	6	7
42) Height (Feet)	____	____	____	____	____	____	____
43) Width (Feet)	____	____	____	____	____	____	____
44) How many layers of thicknesses of glass not counting storm windows? (1, 2, etc.)	____	____	____	____	____	____	____
45) Equipped with storm windows?	___Yes ____No	___Yes ____No	___Yes ____No	___Yes ____No	___Yes ____No	___Yes ____No	___Yes ____No
46) Shaded by (check all that apply):	[Average width of eves__________]						
Trees	____	____	____	____	____	____	____
Awnings	____	____	____	____	____	____	____
Sun Screens	____	____	____	____	____	____	____
Tinting	____	____	____	____	____	____	____
Shades	____	____	____	____	____	____	____
Blinds	____	____	____	____	____	____	____
Drapes	____	____	____	____	____	____	____
Nothing	____	____	____	____	____	____	____
47) Needs Caulking Inside	___Yes ____No	___Yes ____No	___Yes ____No	___Yes ____No	___Yes ____No	___Yes ____No	___Yes ____No
Outside	___Yes ____No	___Yes ____No	___Yes ____No	___Yes ____No	___Yes ____No	___Yes ____No	___Yes ____No
48) Needs weatherstripping	_____Yes _____No	____Yes _____No	____Yes _____No	____Yes _____No	____Yes _____No	____Yes _____No	____Yes _____No

49) How many exterior doors? ________

50) Do any need weatherstripping? ______ Yes
______ No

51) Type: Solid Wood ______ Thin ______ Thick ______ Hollow core ______ Metal Insulated _____

52) Is there a house within 100 feet of the right side of your home? ______ Yes
______ No

WALL AND WINDOW INFORMATION

Left Side of House

Describe the left side of the house. Remember to include all outside walls and windows that face to the left. Treat sliding glass doors and French doors as windows.

41) ________ Overall length of left wall in feet.

	Window # 1	2	3	4	5	6	7
42) Height (Feet)	____	____	____	____	____	____	____
43) Width (Feet)	____	____	____	____	____	____	____
44) How many layers of thicknesses of glass not counting storm windows? (1, 2, etc.)	____	____	____	____	____	____	____
45) Equipped with storm windows?	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No
46) Shaded by (check all that apply): [Average width of eves ________]							
Trees	____	____	____	____	____	____	____
Awnings	____	____	____	____	____	____	____
Sun Screens	____	____	____	____	____	____	____
Tinting	____	____	____	____	____	____	____
Shades	____	____	____	____	____	____	____
Blinds	____	____	____	____	____	____	____
Drapes	____	____	____	____	____	____	____
Nothing	____	____	____	____	____	____	____
47) Needs Caulking Inside	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No
Outside	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No
48) Needs weatherstripping	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No	___Yes ___No

49) How many exterior doors? ________

50) Do any need weatherstripping? ______ Yes
______ No

51) Type: Solid Wood ______ Thin ______ Thick ______ Hollow core ______ Metal Insulated ____

52) Is there a house within 100 feet of the left side of your home? ______ Yes
______ No

CITY UTILITIES OF SPRINGFIELD, MISSOURI

________________ (1) 1 (11)

HOME HEATING
RESIDENTIAL QUESTIONAIRE
(FOR CALCULATION OF HOME HEAT LOSS)

Date (13) mo.____ day ____ yr. ____

Your Name (22)____

Your Correct Address (42)____

City (66)____________________ ZIP Code (68)_______ Phone No. (74**) ________________

Your Account Number With City Utilities ______________________________

Instructions: For each question, please check ☑ the most appropriate answer.

A GENERAL QUESTIONS

2 (11)

1. Do you 13-1 ☐ Own Your Home? 2 ☐ Rent? 3 ☐ Lease?

2. Approximately when was your home built? (14) ________ (Year)

3. What type of house do you have?
   - 18-01 ☐ Ranch type
   - 03 ☐ Cottage
   - 05 ☐ Split level
   - 07 ☐ Duplex
   - 02 ☐ 2 Story
   - 04 ☐ 3 Story
   - 06 ☐ Apartment
   - 99 ☐ Other____________

4. What type of basement do you have? 20-1 ☐ Full 2 ☐ Half 3 ☐ None

5. What is the primary building material of the exterior of your home?
   - 21-01 ☐ Wood Siding
   - 04 ☐ Stucco
   - 07 ☐ All Brick
   - 10 ☐ Cement Block
   - 02 ☐ Asbestos Shingles
   - 05 ☐ Brick Veneer
   - 08 ☐ Brick & Block
   - 99 ☐ Other, Specify_______________________________
   - 03 ☐ Metal Siding
   - 06 ☐ Concrete
   - 09 ☐ Stone

6. Which fuel does your heating system use?
   - 23-1 ☐ Natural Gas
   - 3 ☐ Electricity
   - 5 ☐ Fuel Oil
   - 9 ☐ Other, Specify___________
   - 2 ☐ Wood
   - 4 ☐ Propane
   - 6 ☐ Butane

7. Other than your primary source of heat, check which of the following you use as a second source of heat.
   - 24-1 ☐ Fireplace
   - 3 ☐ Wood Heater
   - 9 ☐ Other, Specify
   - 2 ☐ Electric Heater
   - 4 ☐ None

8. What temperature do you maintain your home
   - (25) Daytime _____ Degrees
   - (27) Evening _____ Degrees
   - (29**) At Night_____ Degrees

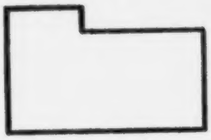
---

(1) 3 (11) B

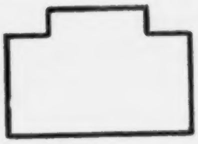
HOUSE SIZE

9. The following are common shapes for floor plans of homes. Please circle the shape which best resembles your house. If none of these describe the general floor plan of your home, please sketch the general outline of your floor plan in the space provided below. Indicate where the garage is located if it is part of the house.

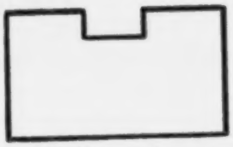
Rectangular



L-Shaped



T-Shaped



U-Shaped

Sketch General Floor Plan of your home if necessary

Total No. of Sq. Ft.

1st Floor 65 ________

2nd Floor 71** ________

10. Please indicate the height and length of each exterior wall of your home in the spaces below. Measure in feet. Please round off values to the nearest foot.

WALL	1	2	3	4	5	6	7	8	9	10
Height of wall										
Length of wall										
	(13)	(17)	(21)	(25)	(29)	(33)	(37)	(41)	(45)	(49)

11. Floor to ceiling height of interior rooms 53 ________ feet.

12 Basement size 55 ________ feet, by 57 ________ feet.
Length Width

13. Is your basement heated? 59 - 1 ☐ Yes 2 ☐ No

14. How much of your basement is above ground? 60 ________ feet.
below ground? 62 ________ feet.

15. What is the primary material of your basement walls?.
64 1 ☐ Concrete 2 ☐ Cement Blocks 9 ☐ Other, Specify

16. Is your attic heated? 13-1 ☐ Yes 2 ☐ No ________ (1) 4 (11)

17. Is your garage heated? 14-1 ☐ Yes 2 ☐ No

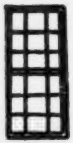
18. Other than your garage do you keep parts of your house unheated? ☐ Yes 2 ☐ No

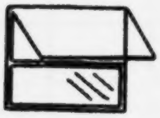
19. Garage size: 16 ________feet, by 18 ________feet
Length Width

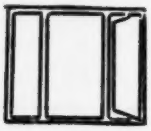
C

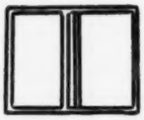
WINDOW INFORMATION

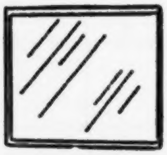
20. The following are common types of windows. Please list the height and width (giving dimensions to the nearest inch) along with the style of each window in the space provided below. Use the diagrams to identify each style and its code. Also indicate how many of each style have storm windows. Be sure and include all windows in the heated portions of your house.

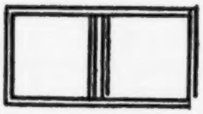

-1- Double Hung


-2- Tilting


-3- Casement


-4- Sliding Pane


-5- Picture or Bay Fixed Pane


-6- Sliding Pane (Basement)

5 (11)

Window Style Code (1-6)									
Height Window									
Width of Window									
Number of Windows of This Size & Style									
How Many Have Storm Windows?									
	(21)	(31)	(41)	(51)	(61)	(71)**	(21)	(31)	(41)

21. Do you close your blinds, shades, curtains or draperies at night? 51-1 ☐ Yes 2 ☐ No

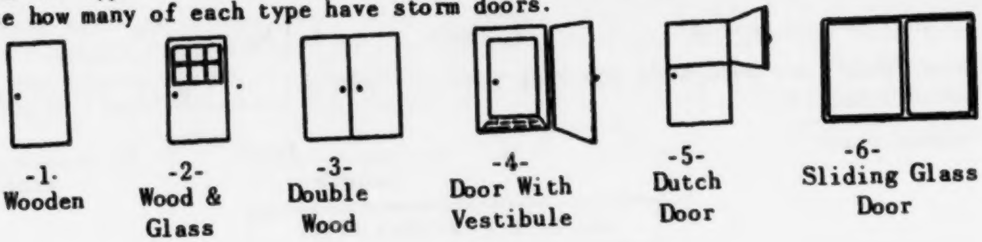
22. On cold, windy days, can you feel air movement around your windows? 52-1 ☐ Yes 2 ☐ No

23. Do you have weatherstripping and/or caulking around your windows? 53**-1 ☐ Yes 2 ☐ No

(1) ______________ 6 (11)

D DOOR INFORMATION

24. The following are common types of exterior doors. Please indicate in the spaces provided the types of doors and the number of each that most resembles yours. Also indicate how many of each type have storm doors.



Door Style:

Door Style Code (1-6)										
Number of Doors of This Style										
How Many Have Storm Doors?										
	(21)	(24)	(27)	(30)	(33)	(36)	(39)	(42)	(45)	(48)

25. On cold, windy days, can you feel air movement around your doors? 51-1 ☐ Yes 2 ☐ No

26. Do you have weatherstripping and/or caulking around your doors? 52-1 ☐ Yes 2 ☐ No

E INSULATION

27. Do you have insulation in your ceiling or attic floor? 53-1 ☐ Yes 2 ☐ No

28. Do you have a floor in your attic? 54-1 ☐ Yes 2 ☐ No

29. If you do have insulation in your ceiling, How much do you have? 55 ____________ inches(depth)

30. What type of insulation is it? 57-1 ☐ Fiberglass 2 ☐ Cellulose 3 ☐ Rock Wool 9 ☐ Other ____________

31. Check also which style it is. 58-1 ☐ Loose-Fill 2 ☐ Blanket 9 ☐ Unknown

32. Are the walls of your house insulated? 59-1 ☐ Yes 2 ☐ No

33. Is your attic ventilated? 60-1 ☐ Yes 2 ☐ No

34. What material is the floor of your house made of?
61-1 ☐ Concrete 2 ☐ Wood 9 Other, Specify ____________

35. Are the floors of your house insulated? 62-1 ☐ Yes 2 ☐ No

36. How thick is your floor insulation 63-- ____________ inches.

(1)

7
(11)

F. WORKSHEET

37. In the spaces provided below enter the Construction Number from Table 2 from the Manual* and the Heat Transfer Coefficient for the exposed outside walls. (Do not include any basement walls which may be above ground.)

		7/8 (11)		9 (11)		10 (10)		11 (10)	
		BASEMENT		FIRST FLOOR		SECOND FLOOR		THIRD FLOOR	
		Const. No.	U	Const. No.	U	Const. No.	U	Const. No.	U
GROSS EXPOSED WALLS	1.	21-23		21-23		21-23		21-23	
	2.	24-26		24-26		24-26		24-26	
	3.								
	4.								
	5.								
	6.								
	7.								
	8.								
	9.								
	10.								
	11.								
	12.								
	13.								
	14.								
	15.								
	16.								
	17.								
	18.								
	19.								
	20.	78-80**		78-80**		78-80**		78-80**	

______________________ 12
(1) (10)

38. Enter the Construction Number and the Heat Transfer Coefficient* for both the Heat Transmission and the Air Infiltration for all the outside doors and windows.

		TRANSMISSION		INFILTRATION	
		Const. No.	U	Const. No.	U
DOORS	1.	21-23		24-26	
	2.	27-29		30-32	
	3.				
	4.				
	5.				
	6.				
	7.				
	8.				
	9.				
	10.	75-77		78-80**	

13
(10)

WINDOWS	1.	21-23		24-26	
	2.	27-29		30-32	
	3.				
	4.				
	5.				
	6.				
	7.				
	8.				
	9.				
	10.	75-77		78-80**	
	11.	21-23		24-26	
	12.	27-29		30-32	
	13.	33-35		36-38	
	14.	39-41		42-44	
	15.	45-47		48-50**	

14
(10)

______________ **15**
(1) (10)

39. **Indicate in the spaces the Construction Number and the Heat Transfer Coefficient* for the ceiling and the floor.**

		Const. No.	U
CEILING	1.	21-23	
	2.	24-26	
	3.	27-29	

FLOORS	1.	30-32	
	2.	33-35	
	3.	36-38**	

* **From P. 34-37, Table 2, Manual J Titled, 'Load Calculations for Residential Winter and Summer Air Conditioning.'**

____________________ 16

(1) (10)

ADDITIONAL INFORMATION:

10. (Cont'd)
Indicate the height and length of each exterior wall of your home in the spaces below. Measure in feet. Round off values to the nearest foot.

WALL	11	12	13	14	15	16	17	18	19	20
Height of wall										
Length of wall										
	(13)	(17)	(21)	(25)	(29)	(33)	(37)	(41)	(45)	(49) **

17

(10)

20. (Cont'd)
List the height and width (Giving dimensions to the nearest inch) along with the style of each window in the space provided below. Use the diagrams on page 3 of the form to identify each style and its code.

Window Style Code (1-6)						
Height Window						
Width of Window						
Number of Windows of This Size & Style						
How Many Have Storm Windows?						
	(21)	(31)	(41)	(51)	(61)	(71)**

City of Palo Alto Utilities Department

HOME CONSULTATION PROGRAM

Address: ______________________

Account No. ______________________

1. Meter Route
2. House Flat Apartment Other ______________________
3. Square Feet ______________
4. Age (years) ______________
5. Brick Stucco Frame Masonry Other ______________
6. Number of bathrooms __________
7. Owner Renter Lessee
8. In this space, draw a floor and include number of doors and all windows with dimensions, exposure, and need for weatherstripping.

HOME CONSULTATION CHECKLIST

ALL QUESTIONS ARE BASED UPON PRE-INSPECTION CONDITIONS.

HEAT AND HEAT LOSSES

A. Furnace

1. Is pilot turned off? _____Yes _____No 0 no furnace
2. Are burners adjusted? _____Yes _____No 0
3. Are ducts insulated? _____Yes _____No 0
4. How many more ducts can be closed? ______________
5. Is the filter clean? _____Yes _____No
6. How often is it cleaned during the heating seasons? __________
7. Is heat used in summer? _____Yes _____No

B. Heat Loss

1. Attic insulated? _____Yes _____No R-value of insulation____________
2. Wall insulated _____Yes _____No
3. Clearance for insulation? __________ inches
4. Door infiltration? _____Yes _____No
5. Window infiltration? _____Yes _____No
6. Electrical outlet infiltration? _____Yes _____No
7. General infiltration? _____Yes _____No
8. Curtains being used? _____Yes _____No 0 no curtains
9. Fireplace damper used? _____Yes _____No 0 no fireplace

C. Thermostat Setting

1. Daytime temperature (degrees)__________
2. Night temperature (degrees)__________

D. Other Gas Appliances

1. Stove
    a. Burner pilots on? _____Yes _____No 0 no stove
    b. Excessive cooking? _____Yes _____No 0 no cooking

2. Dryer
   - a. Gas or electric
   - b. Filter clear? ____Yes ____No
   - c. Run on full loads? ____Yes ____No
   - d. How many weekly loads? ________
   - e. Would customer use a clothesline? ____Yes ____No

3. Miscellaneous
   - a. Flood lights or safety lights outside? ____Yes ____No
   - b. Fireplace pilot? ____Yes ____No
   - c. Electric stove? ____Yes ____No

ELECTRICITY

A. Refrigerator
   1. Number of units? ________
   2. Number of units with bad gaskets? ________
   3. Number of units with dirty coils? ________
   4. Number of units with poor ventilation? ________
   5. Number of units near heat source? ________
   6. Number of units needing defrosting? ________
   7. Number of units with humidity switch on? ________
   8. Size of refrigerator? (cubic feet) ________
   9. Automatic defrost or manual defrost

B. Lighting
   1. Unneeded lights? ____Yes ____No
   2. Overpowered lights? ____Yes ____No
   3. Task lighting substitute? ____Yes ____No
   4. Number of fluorescents? (fixtures) ________
   5. How many lights are used over four (4) hours per day? ________

C. Other Electric Appliances

1. T.V. instant on? _____Yes _____No 0 no T.V.
2. Electric blanket used? _____Yes _____No 0 no blanket
3. Waterbed heater? _____Yes _____No 0 no waterbed
4. Dishwasher dryer on? _____Yes _____No 0 no dishwasher
5. Washing machine run on full load only? _____Yes _____No 0 no washing machine
6. Washing temperature? _____Hot _____Cold _____Warm
7. Rinse temperature? _____Hot _____Cold _____Warm
8. Freezer defrosted? _____Yes _____No
9. Can freezer be insulated? _____Yes _____No
10. Freezer size (cubic feet) __________

WATER

A. Leaks

1. Hot water leaks? _____Yes _____No
2. Cold water leaks? _____Yes _____No
3. Toilet leaks? _____Yes _____No

B. Flow Restrictors

1. Low flow showerheads? _____Yes _____No
2. Toilet bottles/dams _____Yes _____No
3. Aerators? _____Yes _____No
4. No flush—yellow is mellow _____Yes _____No
5. Number of showers? _____Yes _____No
6. How long? _____Yes _____No

C. Greywater Sources and Use

1. Bathroom? _____Yes _____No
2. Kitchen? _____Yes _____No
3. Laundry? _____Yes _____No
4. Proper use? _____Yes _____No

   If no, please explain here:

5. Used on plants? _____Yes _____No
6. Used for flushing? _____Yes _____No

D. Water Heater

1. Temperature (degrees) ____________
2. Hot water scarcity? _____Yes _____No
3. Insulated? _____Yes _____No
4. Clearance for insulation? _____Yes _____No
5. Total capacity? (gallons) ____________

E. Renovations and New Appliances (optional)

1. Energy conserving refrigerator? _____Yes _____No 0 no new unit
2. Automatic defrost? _____Yes _____No
3. Gas stove/electric ignite? _____Yes _____No
4. Electric stove? _____Yes _____No
5. Water heater? _____Yes _____No
6. Dishwasher? _____Yes _____No
7. Washing machine? _____Yes _____No
8. Double-glazed window? _____Yes _____No
9. Wall insulation? _____Yes _____No
10. Number of fluorescents ____________
11. Skylights? _____Yes _____No
12. Solar
    a. Water heating? _____Yes _____No
    b. Space heating/active _____Yes _____No
    c. Space heating/passive _____Yes _____No

Appointment Date ____________ | Account No: ____________

____________ am/pm

Preliminary
Home Energy Survey

NAME: ______________________________ PHONE: ____________

ADDRESS: ______________________________ APPLICATION DATE: ____________

DIRECTIONS:

(1) Do you ☐ Own, or ☐ Rent?

(2) Type of Home? ☐ One-Story ☐ Two-Story ☐ Split Level ☐ Cape Cod

☐ Apartment ☐ Duplex ☐ Mobile Home ☐ Other ______

Siding: ☐ Wood ☐ Brick ☐ Masonite ☐ Other ____________

Foundation: ☐ Crawl Space ☐ Slab ☐ Basement ☐ Other ________

(3) Age of Home? ______ Years, OR General Condition of Rental Unit: ____________

(4) How Many Square Feet of Heated Space? ____________

(5) How is Home Heated? ____ Electric _____ Oil ______ Gas

Usual Day Thermostat Setting: ________ degrees

Usual Night Thermastat Setting: ________ degrees

Type

☐ Heat Pump

☐ Central Furnace

☐ Floor Furnace

☐ Room Heaters

☐ Other ______

(6) How is Home Cooled? ☐ Central A/C: ______Units

☐ Window A/C: ______Units

☐ Other ____________

Usual Thermastat Setting: _____degrees

(7) Number in Family (or Residence): _____Adults, _____ Children, _____ Total

(8) Water Heater: ☐ Electric Capacity: ________ gallons

☐ Non-Electric Thermostat(s): ________

Is Hot Water Too Hot to Touch: ____________

Location of Water Heater: ____________

Do you Want Temperature Lowered: ____________

(9) Major Appliances, Lighting: ☐ Freezer - M-F; ☐ Dishwasher;

☐ Dryer ☐ Outside Lighting

Comments: ______________________________

____

10. Fireplace? ☐ Conventional, ☐ Other ______________________________

Used Frequently? ______________________________

Comments: ______________________________

11. Existing Insulation? ______ Attic, ______ Walls, ______ Floors

12. Windsow/Doors: Storm Windows? ______________

Storm Doors? ______________

Large Glass Areas? ______________________

Caulking & Weatherstripping? ______________________

13. Visible Moisture Problems: ______________________________

____

14. Do You Read Your Meter? __________

Would You Like for Us to Show You How? __________

15. Any Specific Problem(s)? ______________________________

____

____

____

____

Greenville Utilities Commission

Data Survey for Heat Loss Calculation

Acct. No. ____________

Customer ______________________________ Date ____________ 19 ____

Address ______________________________ Phone: Home ____________ Bus. ____________

Energy Checker ______________________________ Time In ______ Out ______

1. Direction House Faces: S E N W   Shaded: Yes ☐ No ☐

2. Sketch of House

1st Floor	2nd Floor
ceiling height ______ x running wall = ______ gross wall	ceiling height ______ x running wall = ______ gross wall

3. Caulking: Windows: Good ☐ Needed ☐   Doors: Good ☐ Needed ☐

4. Weatherstripping: Windows: Good ☐ Needed ☐   Doors: Good ☐ Needed ☐

5. Type of Attic Ventilation: Gable ☐ Soffit ☐ Roof Fan ☐ Other ____________

6. Floor Over: Slab ☐ Basement ☐ Crawlspace ☐ Wet? ☐ Dry? ☐

Heating/AC Ducts Insulated? Yes ☐ No ☐

Inside Survey:

5. Doors

Type	Sizes in Sq. Ft. 18 or 20	No. With Storm	No. W/O Storm	Sq. Ft. w/storm	Sq. ft. w/o storm
	18 20				
	18 20				
	18 20				
	18 20				

6. Windows:

	Sizes With Storm	Sizes W/O Storm	Sq. Ft.	No. of Units	Total Square Feet	
					w/storm	w/o storm
N___						

	Sizes With Storm	Sizes W/O Storm	Sq. Ft.	No. of Units	Total Square Feet	
					w/storm	w/o storm
E___						
S___						
W___						

7. Insulation:

Area	Type	Inches	R-Value
Ceiling			
Walls			
Floor			

Sheathing Type ______________

8. Call data in to office: 752-7166, Extension 252, 254, 234, 244.

The ENERGY CHECK Program
Greenville Utilities Commission

Customer Name ______________________ Date ______19___
Service Address ______________________ Time ______
Account Number __________ Telephone No. __________ Home Direction
__________ Bus. House Faces ______

Taken From Data Survey:

Insulation:	Type	No. of Inches	R-Value
Ceiling			
Walls			
Floors			

Windows:

Single pane sq. ft. _____ Weatherstripping _____
Dbl. glazed sq. ft. _____ Caulked? _____

Doors:

Wood sq. ft. _____ Storms? _____
Metal sq. ft. _____ Weatherstripped? _____

Areas Checked and Conditions Found:

Yes ☑ No ☑ (or N/A)

- ☐ ☐ Sufficient attic ventilation
- ☐ ☐ Crawlspace is dry
- ☐ ☐ Crawlspace is properly ventilated
- ☐ ☐ Heating/AC ducts are insulated
- ☐ ☐ Attic access door is weatherstripped
- ☐ ☐ Vapor barrier in attic insulation is faced down
- ☐ ☐ Floor registers are tightly fit
- ☐ ☐ Heating/AC thermostat is accurate
- ☐ ☐ Fireplace has an enclosure
- ☐ ☐ Fireplace damper is closed
- ☐ ☐ Water heater thermostat properly set
  Upper _____ to _____
  Lower _____ to _____
- ☐ ☐ Furnace/AC filter is clean
- ☐ ☐ Appliance gaskets are intact

Recommendations

The ENERGY CHECK Program

Questionnaire

Customer Name ______________________________ Date ______ 19___

Service Address ______________________________

Please place a ☐ by the appropriate answer (NOTE: Comments will be helpful)

1. Was the energy inspection what you expected?

   Yes ☐ No ☐ Comment: ______________________________

2. Was the energy inspection helpful to you in that you would recommend this service to your friends?

   Yes ___ No ___ Comment: ______________________________

3. Was the time which the energy inspection spent in your home:

   Efficient Yes ☐ No ☐
   Informative Yes ☐ No ☐ Comment: ______________________________

4. Did the energy inspector effectively point out areas where you could conserve energy in your home?

   Yes ☐ No ☐ Comment: ______________________________

5. How would you describe the Home Inspection Report which was mailed to you after the survey?

   Vague ☐ Understandable ☐

6. How would you describe the Home Inspection Service which you received? Clear, Helpful, Comprehensive?

   Yes ☐ No ☐ Comment: ______________________________

7. a) What improvements to your home have you made which were recommended to you by our Home Inspection Program?

   ____

   ____

   b) What improvements are you planning to make? ______________________________

   ____

   c) If you do not plan to follow through with any of the recommendations, or only some of them, what are your main reasons for not doing so?

   ☐ Cost of the recommendations ☐ Don't Agree With Recommendations
   ☐ Do Not Think It Is Worth the Investment ☐ Other

   Comment: ______________________________

8. Would you describe the energy inspector?

Knowledgeable Yes ___ No ___ Comment: ______________________________

Helpful Yes ___ No ___ ______________________________

Considerate Yes ___ No ___

9. Please make any recommendations as to how the Home Inspection Program can be more effective in helping other customers to save energy in their homes:

Thank You,

____

____

Energy Conservation and Management
Greenville Utilities Commission
P. O. Box 1847
Greenville, NC 27834

AN ENERGY PROFILE OF YOUR HOME

The figures in the chart below have been calculated specifically for your home. They show the amount of heat that is lost through various parts of your house each hour, assuming that it's 20 degrees outside and you're maintaining an indoor temperature of 70 degrees. The figures are expressed in units of measurement called British Thermal Units or BTU's (refer to the pamphlet included in your folder entitled, Energy Dictionary, for a definition of "BTU," as well as other energy conservation terms).

The size of your monthly heating (and cooling) bills is very much related to the size of the BTU's-per-hour figures you see in the chart: "The faster the BTU's flow, the more energy dollars that go." That's why adding such energy improvements as insulation, storm windows, caulking, and weatherstripping leads to big savings--fewer BTU's of energy are needed to maintain the desired temperature setting. And, if you use air conditioning during warm weather, the BTU's-per-hour figures below also tell you something about the ability of your home to keep in the cool air. Energy Home Improvements pay for themselves year 'round!

ENERGY PROFILE CHART FOR YOUR HOME

Home Area	Existing Insulation and/or Conditions	Home Heat Loss in BTU's Per Hour	
		Existing Home Heat Loss	If Recommendations are Followed:
Windows			
Doors			
Walls			
Ceiling			
Floors			
Air Leakage Throughout Home			
	Total Heat Loss (BTU's)		
	Heat Loss Per Square Foot (BTU's)		

Your Home Has Approximately ____________ Square Feet of Heated Living Area

APPENDIX F

CONSERVATION PRODUCT LOAN QUESTIONNAIRE

1. Is your institution presently making home improvement loans specifically for energy conservation measures?

   ☐ yes ☐ no

2. Is your institution presently making loans under Title I of the National Housing Act for Energy Conservation Home Improvement?

   ☐ yes ☐ no

3. What is:

	minimum amount loaned	minimum interest rate	available repayment periods
Home Improvement Loan			
Energy Conservation Loan			
National Housing Act Conservation Loan			

4. The Energy Act anticipates that conservation measure loans from $100 and higher would be granted by financial institutions.

   a. What would be the minimum amount of loan you would make? $__________

   b. At what interest rate? __________% (approximately)

   c. Would a loan set up fee be charged? ______ If so, how much? $__________

   d. If we collected the periodic payments (principal and interest) for you, would that make a difference in minimum amount loaned and/or interest rate?______ In what way?__________

   e. If GNMA insured these loans, would you lower the minimum amount of loan and/or change the interest rate? ______ If so, how?__________

   f. What additional conditions would you require to participate in financing purchases in amounts less than $1,000?__________

   g. What problems do you foresee in carrying out the Energy Act in relation to financing measures?__________

5. For further information, who may we contact?

   Name__________ Title__________

   Institution__________ Phone__________

   Address__________

Courtesy: Salt River Project, Phoenix, Arizona

APPENDIX G

RETAIL STORES WHERE ENERGY-SAVING DEVICES ARE SOLD

Store	Photoelectric Light Control	Shower Flow Restrictor	Duct Tape	Hot Water Pipe Insulation	Weatherstripping	Fuel Sentry Thermostat Override	Comments
Ace Hardware, M.V.	✓	✓	✓	✓	✓		
Appliance Parts Co., P.A.			✓	✓			Emergency plumbing repair kit, clogged filter flag, oiler for furnace
Builders Emporium, R.C.	✓		✓	✓	✓		Plumbing repair kit, fluorescent tubes & fixtures
Eyerly's Hardware, P.A.	✓	✓	✓	✓	✓		
Home Plumbing Supplies, M.V.			✓	✓			Water-saver toilets, water-saver showers, heat duct insulation
The Householder, L.A.			✓		✓		One-cup coffee heaters, wind-up timers
Marsh Manor Hardware, R.C.	✓		✓	✓	✓		
Copeland Plumbing and Heating, R.C.		I	✓	✓		I	

✓ = Now carry
I = Intend to carry in near future

P.A. = Palo Alto
L.A. = Los Altos
M.V. = Mountain View
R.C. = Redwood City

LOCAL INSULATION CONTRACTORS

The following is a list of establishments which install insulation, caulking, and/or weatherstripping. An X listed under particular items indicates which functions that company performs. This list was compiled from responses to a survey of local insulation contractors conducted by the City of Palo Alto Utilities Department, and does not represent an endorsement of the contractors. This list is not comprehensive. Any insulation contractor who is not listed should notify the City of Palo Alto Utilities Department, c/o Conservation Office, for inclusion the next time the list is revised.

	Installs					
Name	Insul.	Weather-stripping	Caulking	Duct Insul.	Offer Guarantees	Provide Certificates
Sears 455 San Antonio Road Mountain View, Calif. 948-8511 ext. 381	X				X	X
Hans Stavn Contractor 2250 Princeton Street Palo Alto, Cal. 94306 332-3591	X	X	X	X	X	
Alten Corporation 2594 Leghorn Street Mountain View, Cal. 969-6474	X				X	

APPENDIX H

WEATHERIZATION ASSISTANCE PROGRAM
FOR
LOW-INCOME PERSONS

Program Definition

The Department of Energy's (DOE) Weatherization Assistance Program assists low-income people, particularly the elderly and handicapped in cutting energy consumption and costs. This is accomplished through the installation of energy conserving measures in eligible dwelling units.

Eligibility

In order to be eligible for weatherization assistance, a household must be within 125 percent of OMB poverty guidelines or have had someone in the household receive benefits under Title IV or XVI of the Social Security Act during the preceding twelve months. Under current guidelines, a non-farm family of four with an income at or below $9,313 would be eligible for assistance.

Program Operation

DOE provides grants to States, the District of Columbia and Indian tribal organizations. The funds are then distributed by the States and the District to the local governments and/or local non-profit organizations. The actual weatherization work is done at the local level through more than 1,000 local governments and non-profit organizations.

The local agencies have a work force comprised of CETA employees, volunteers, contractors, and direct labor. This provides training and employment for low-income persons in the community, and supports the active participation of community organizations in energy conservation projects. When hiring contractors the agencies are encouraged to contract with non-profit organizations or businesses owned by disadvantaged individuals.

Funds are used to install insulation, storm windows, caulking, weatherstripping, furnace efficiency modifications, and other improvements designed to reduce heat loss and conserve energy. The actual energy conservation measures installed in a home are based on the energy audit procedure contained in Project Retro-Tech. Project Retro-Tech calculates for each type of dwelling unit the cost-effectiveness of a weatherization measure, and its priority, in terms of payback.

Appropriations

The program became operational in DOE (FEA) in 1977. DOE's program ran parallel to the Community Services Administration's low-income weatherization program in fiscal years 1977 and 1978. Appropriations for the DOE Weatherization Assistance Program for fiscal years 1977 through 1980 are $490.5 million. The program has been reauthorized for fiscal year 1981. The President's fiscal year 1981 budget requests $188.9 million in new appropriations.

Accomplishments

Since the inception of the Weatherization Assistance Program approximately 400,000 low-income homes have been weatherized with DOE funds. Annual energy savings range from 12-15 percent per home. Monthly data is received to assess the status of the program in the field.

Recent program changes allow the expenditure of up to $1,600 per home to hire labor to install materials when local agencies experience labor shortages of CETA and/or volunteers. The use of community-based organizations and small minority owned businesses as contractors can stimulate economic development in both urban and rural communities.

Interagency Coordination

DOE coordinates with the Community Services Administration, Department of Health and Human Services, Department of Housing and Urban Development, Department of Labor, Farmers Home Administration, and ACTION in implementing the weatherization program and in integrating the various energy programs for low-income persons. Community Action Agencies, whose mission is to further self-sufficiency for low-income persons, are the majority of local administering agencies in the weatherization program.

For Additional Information Contact

Office of Weatherization Assistance Program, Conservation and Solar Energy, Department of Energy, Washington, D.C. 20585, Telephone (202) 252-2207/2476.

POVERTY INCOME GUIDELINES FOR ALL STATES EXCEPT ALASKA AND HAWAII

Size of Family Unit	Nonfarm Family		Farm Family	
	100%	125%	100%	125%
1	$ 3,790	$ 4,738	$ 3,250	$ 4,063
2	5,010	6,263	4,280	5,350
3	6,230	7,788	5,310	6,638
4	7,450	9,313	6,340	7,925
5	8,670	10,838	7,370	9,213
6	9,890	12,363	8,400	10,500

For family units with more than 6 members, add (at the 100 percent level), $1,220 for each additional member in a nonfarm family and $1,030 for each additional member in a farm family. For family units with more than 6 members, add (at the 125 percent level) $1,525 for each additional member in a nonfarm family and $1,288 for each additional member in a farm family.

POVERTY GUIDELINES FOR ALASKA

Size of Family Unit	Nonfarm Family		Farm Family	
	100%	125%	100%	125%
1	$ 4,760	$ 5,950	$ 4,090	$ 5,113
2	6,280	7,850	5,370	6,713
3	7,800	9,750	6,650	8,313
4	9,320	11,650	7,930	9,913
5	10,840	13,550	9,210	11,513
6	12,360	15,450	10,490	13,113

For family units with more than 6 members, add (at the 100 percent level), $1,520 for each additional member in a nonfarm family and $1,280 for each additional member in a farm family. For family units with more than 6 members, add (at the 125 percent level) $1,900 for each additional member in a nonfarm family and $1,600 for each additional member in a farm family.

POVERTY GUIDELINES FOR HAWAII

Size of Family Unit	Nonfarm Family		Farm Family	
	100%	125%	100%	125%
1	$ 4,370	$ 5,463	$ 3,760	$ 4,700
2	5,770	7,213	4,940	6,175
3	7,170	8,963	6,120	7,650
4	8,570	10,713	7,300	9,125
5	9,970	12,463	8,480	10,600
6	11,370	14,213	9,660	12,075

For family units with more than 6 members, add (at the 100 percent level) $1,400 for each additional member in a nonfarm family and $1,180 for each additional member in a farm family. For family units with more than 6 members, add (at the 125 percent level) $1,750 for each additional member in a nonfarm family and $1,475 for each additional member in a farm family.

GOVERNOR-DESIGNATED STATE GRANTEES

STATE	ADDRESS	TELEPHONE
Alabama	Mr. Edwin Hudspeth, Director Alabama Energy Management Board Alabama Development Office State Capitol Montgomery, Alabama 36130 Attention: Corinne Wentowski	(205) 832-5010
Alaska	Ms. Clarissa M. Quinlan, Director Division of Energy & Power Development Department of Commerce & Economic Development MacKay Building 338 Denali Street Anchorage, Alaska 99501	(907) 276-1169
Arizona	Mr. Larry Landry, Executive Director Office of Economic Planning and Development 1700 W. Washington Phoenix, Arizona 85007	(602) 255-4872 FTS 8-765-4872
Arkansas	Mr. James McGuire Division of Community Services First National Building Suite 971 Little Rock, Arkansas 72201	(501) 371-1201
California	Ms. Alice Huffman California State Economic Opportunity Office Energy Conservation Division 555 Capitol Mall, Suite 325 Sacramento, California 95814	(916) 322-2940
District of Columbia	Mr. Robert L. Moore, Director D.C. Department of Housing and Community Development 1341 G Street, N.W., Suite 312 Washington, D.C. 20005 Attention: Tom Wooden	(202) 724-8721 (202) 724-2026
Colorado	Ms. Paula Herzmark Executive Director Department of Local Affairs 1313 Sherman Street, Rm. 518 Denver, Colorado 80203	(303) 839-2771

STATE	ADDRESS	TELEPHONE
Connecticut	Mr. Ronald E. Manning, Commissioner Connecticut Department of Human Resources Development 1179 Main Street P.O. Box 786 Hartford, Connecticut 06101	(203) 566-3318 FTS 8-641-3318
Delaware	Mr. Robert S. Moyer, Acting Secretary of the Department of Community Affairs and Economic Development 630 State College Road Dover, Delaware 19901	(302) 736-4456
	Attention: Doug Waun	(302) 571-3491
Florida	Mrs. Joan Heggen, Secretary Department of Community Affairs Division of Community Services 2571 Executive Center Circle, East Tallahassee, Florida 32301	(904) 488-7541
Georgia	Mr. Mark Zwecker, Director Office of Energy Resources 270 Washington Street, S.W. Atlanta, Georgia 30334 Attention: Mr. Rob Harvey	(404) 656-5176
Idaho	Mr. John L. Chamberlin, Director Department of Health and Welfare Idaho State Economic Opportunity Office Statehouse Boise, Idaho 83720	(208) 334-4230
Illinois	Mr. David Farrell, Chief Office of Resource Conservation 325 W. Adams, 4th Floor Springfield, Illinois 62706	(217) 785-3189

STATE	ADDRESS	TELEPHONE
Indiana	Ms. Jean Merritt, Executive Director Office of Community Services Administration Suite 212 20 N. Meridian Street Indianapolis, Indiana 46204	(317) 633-7006 FTS 8-336-7006
Iowa	Mr. Robert F. Tyson, Director State Office of Economic Opportunity Planning and Programming 523 E. 12th Street Capitol Annex Des Moines, Iowa 50319	(515) 281-3855 FTS 8-281-3855
Kansas	Ms. Mary Lux, Community Program Consultant Kansas State Economic Opportunity Office 535 Kansas Avenue Topeka, Kansas 66603	(913) 296-2458 FTS 8-854-2867
Kentucky	Mr. Harold L. Steele, Manager Planning Branch Department for Human Resources DHR Building (6th Floor, West) 275 E. Main Street Frankfort, Kentucky 40621	(502) 564-3194 FTS 8-351-3194
Louisiana	Ms. Rose Trahan Department of Urban and Community Affairs P.O. Box 44455 Baton Rouge, Louisiana 70804	(504) 925-3730
Maine	Mr. Timothy P. Wilson, Director Division of Community Services State House Augusta, Maine 04333	(207) 289-3771 FTS 8-868-3771
Maryland	Mr. Kalman R. Hettleman, Secretary Department of Human Resources 1100 N. Eutaw, Room 615 Baltimore, Maryland 21201 Attention: Frank Welsh	(301) 383-5528 FTS 8-932-2500 (301) 383-2500

STATE	ADDRESS	TELEPHONE
Massachusetts	Mr. Byron J. Matthews, Secretary Executive Office of Communities and Development 100 Cambridge Street, Room 1404 Boston, Massachusetts 02202	(617) 727-7765
Michigan	Mr. James Norman, Director Bureau of Community Services Michigan Department of Labor 7150 Harris Drive P.O. Box 30015 Lansing, Michigan 48909	(517) 322-1726 FTS 8-253-1837 Ext. 21726
Minnesota	Mr. Rolf Middleton, Commissioner Office of Economic Opportunity Department of Economic Security 150 E. Kellogg Boulevard 690 American Center Building St. Paul, Minnesota 55101 Attention: Allen Chapman	(612) 296-6706 FTS 8-776-3885 FTS 8-776-5752
Mississippi	Mr. Clovis Williams, Director Governor's Office of Human Resources and Community Services Suite 400 Barefield Complex 802 N. State Street Jackson, Mississippi 39201 Attention: Mike Zwickel	(601) 354-6099
Missouri	Mr. Ron Wyse, Director Division of Energy Department of Natural Resources P.O. Box 176 1915 South Ridge Drive Jefferson City, Missouri 65101	(314) 751-4000
Montana	Mr. John Allen, Administrator Department of Community Affairs Human Resources Division Capitol Station Helena, Montana 59601	(406) 449-3420

STATE	ADDRESS	TELEPHONE
Nebraska	Mr. Bill Palmer, Director Nebraska State Energy Office P.O. Box 95085 9th Floor - State Capital Lincoln, Nebraska 68509	(402) 471-2867 FTS 8-854-2867
Nevada	Ms. Linda Ryan Nevada Office of Community Services 201 W. Telegraph Room 203 Carson City, Nevada 89710	(702) 885-4420
New Hampshire	Ms. Stephanie Eaton Administrator New Hampshire Division of Human Resources 15 North Main Street Concord, New Hampshire 03301	(603) 271-2611 FTS 8-842-2611
New Jersey	Mr. E. Bob Minter, Supervisor Office of Low-Income Energy Conservation Department of Community Affairs 363 West State Street Trenton, New Jersey 08625	(609) 292-6140 FTS 8-477-2148
New Mexico	Mr. Jerry Kloeppel Community Affairs Bureau Room 103A, P.O. Box 2348 Pera Building Santa Fe, New Mexico 87503	FTS 8-476-2205
New York	Mr. Horace Morancie, Director New York State Department of State Division of Economic Opportunity 162 Washington Avenue Albany, New York 12231	(518) 474-5700
North Carolina	Mr. James E. Gibson, Jr., Director North Carolina Energy Division North Carolina Department of Commerce P.O. Box 25249 Raleigh, North Carolina 27611 Attention: William Brooks	(919) 733-4490 FTS 8-733-2230

STATE	ADDRESS	TELEPHONE
North Dakota	Honorable Wayne Sanstead Lieutenant Governor Federal Aid Coordinator Community Action Assistance State Capitol Building Bismarck, North Dakota 58501	(701) 224-2467
Ohio	Dr. Bennett J. Cooper Deputy Director Community Services Division Department of Economic and Community Development P.O. Box 1001 Columbus, Ohio 43216	(614) 466-6954 FTS 8-942-2969
Oklahoma	Ms. Margaret Synder Division of Economic Opportunity 5500 North Western Avenue Oklahoma City, Oklahoma 73118	(405) 840-2811
Oregon	Ms. Ellen A. Schneider Program Manager Oregon State Community Services Program 772 Commerical Street, S.E. Salem, Oregon 97210	(503) 378-4729
Pennsylvania	Ms. Shirley M. Dennis, Secretary Department of Community Affairs Room 317, Forum Building Harrisburg, Pennsylvania 17120 Attention: Jerry Astolfi	(717) 787-7160 FTS 8-637-2576 (717) 783-2967
Rhode Island	Mr. Frederick Williamson Director Department of Community Affairs 150 Washington Street Providence, Rhode Island 02903	(401) 277-2850 FTS 8-412-2850
South Carolina	Mr. J. Lee Spratt, Director Division of Ecomonic Opportunity State Economic Opportunity Office 1712 Hampton Street Columbia, South Carolina 29201	(803) 758-3191

STATE	ADDRESS	TELEPHONE
South Dakota	Mr. Peter Goodwin, Director State Economic Opportunity Office State Capitol Pierre, South Dakota 57501	(605) 773-3663
Tennessee	Ms. Zeller Waller, Director Tennessee Community Services Administration 444 James Robertson Parkway Nashville, Tennessee 37219	(615) 741-2615 FTS 8-853-2615
Texas	Mr. Charles Chapman Texas Department of Community Affairs P.O. Box 13166 Capitol Station Austin, Texas 78711	(512) 475-6601
Utah	Mr. Jack Lyman State Energy Office 231 E. 400 South Suite 101 Salt Lake City, Utah 84111	(801) 533-5424
Vermont	Sister Elizabeth Candon Secretary Agency for Human Services 103 South Main Street Waterbury, Vermont 05676	(802) 241-2224 FTS 8-832-6501
Virginia	Mr. William L. Lukherd Commissioner of Welfare 8007 Discovery Drive Richmond, Virginia 23280 Attention: Lollie Chapman	(804) 281-2936 FTS 8-936-1575 (804) 936-1798
Washington	Mr. Wayne Aragon, Administrator Office of Economic Opportunity Washington State Planning and Community Affairs Agency 400 Capitol Center Building Olympia, Washington 98504	(206) 753-4931

STATE	ADDRESS	TELEPHONE
West Virginia	Mr. Douglas J. Skaff, Director Administrative Services Governor's Office of Economic Opportunity and Community Development West Wing 144 State Capitol Building Charleston, West Virginia 25305	(304) 348-0350 FTS 8-885-3562
	Attention: Peter Sandwall	(304) 348-3390
Wisconsin	Mr. Don Percy, Secretary Department of Health and Social Services Division of Economic Assistance 18 South Thornton Avenue P.O. Box 8913 Madison, Wisconsin 53707	(608) 266-7456 FTS 8-366-2710
Wyoming	Ms. Pam Abel Wyoming Energy Conservation Office 320 W. 25th Street Capitol Hill Office Building Cheyenne, Wyoming 82002	(307) 777-7131

APPENDIX I

RESIDENTIAL CONSERVATION SERVICE (RCS) SUMMARY

The Final RCS rule was published in the Federal Register on November 7, 1979 and became effective December 7, 1979.

The principal program elements include:

A. Program Announcement

B. Home Energy Audit

C. Lists of Contractors, Lenders, and Suppliers

D. Arrangement of Installation and Financing

E. Material and Installation Standards

F. Post-Inspection of Installation

G. Consumer Grievance Procedures

H. Opportunity to Repay Loans Through the Utility

The major differences between the original Proposed Rule and the Final Rule are:

Proposed Rules	Final Rule
1. Required Two Audits	1. Requires One Audit
2. Strict Post Inspections Required	2. Post Inspection Requirements Eased and Reduced
3. Delivery of Audit Results in Person	3. State Can Propose Alternatives
4. Strict Material and Installation Standards	4. Material and Installation Standards Reduced
5. No Scheduling of Audits Allowed	5. Scheduling of Audits Allowed
6. State Could Not Add Measures	6. State Addition of Measures Authorized
7. Class "B" Audit Not Allowed	7. Class "B" Audits Permitted (With Quality Assurance Requirements)
8. Only One Bill Allowed for Improvements and Utility Costs	8. Separate Billing Apart from Utility Billing Allowed
9. No Do-It-Yourself Information Allowed	9. Do-It-Yourself Information Added to Audit

PROGRAM ANNOUNCEMENTS

In the Program Announcement the utility must include lists of program measures and estimates of potential savings; state measures and estimates of savings; and practices and estimates of savings. The utility must offer Class "A" and Class "B" program audits (which may be conditioned on geographic location and utility usage); help in arranging installation and financing; and lists of suppliers, contractors, and lenders. In addition, the utility must supply descriptions of customer benefits as identified in the Regulation and information on tax credits and weatherization assistance programs. Finally, the utility must provide disclosure regarding the constraints to achieving potential savings (household behavior, rising fuel prices, etc.).

AUDITS

The RCS program Class "A" audit requires an on-site inspection of the residence by an employee of the utility or a contractor to the utility; information on low-cost/no-cost practices that are recommended as First Steps; and an offer by the utility to arrange installation and financing. The utility must provide estimates of costs and savings for all applicable program measures; estimates of costs and savings of state measures (if included); information on tax credits and weatherization assistance; list of contractors, suppliers, and lenders; and a description of customer benefits. All results must be delivered in person (or by a DOE-approved alternative).

Class "B" Audits may not be used as a precondition for Class "A" audits and are t be offered "in conjunction with" rather than "instead of" other services. If a Class "B" audit (computer printout/mailed forms) is offered, it must cover all measures included in the "A" audit. The utility is responsible for attempting to get complete information from the homeowner.

Availability of audits must be included in program announcements, which must be distributed within six months of the approval of the state plan. All customers who are given a conditional offer of an audit must be recontacted and given an unconditional offer within two years of the conditional offer.

Auditing other fuels can be sub-contracted, or outside training can be secured for utility employees if the utility chooses to do the auditing itself.

The state plan can add conservation measures but these measures cannot increase the customers' audit cost. Also, the state must describe how these measures are offered in conjunction with RCS. State plans must include auditor qualifications. In addition, the state will determine a "reasonable time" for completion of audits, and will establish the cost of the audit.

ARRANGING (Installation & Financing)

The utilities must offer to arrange for installation and financing of conservation measures. Service must be more than distribution of lists. The minimum level of service will be to give the customer a choice of: (1) being provided with a list of contractors and lending institutions, if any, and agreeing to install or finance measures at the auditor's estimated cost; or (2) assistance in obtaining bids. Utilities may only arrange for installation and financing with names on the master record.

States will prepare and maintain a master record of suppliers, lenders, installers, and contractors. The state has the option to require utilities to assist in compiling master records. States must notify utilities within 30 days of additions and deletions to lists; must update the lists every 30 days; and must establish delisting and relisting procedures.

ACCOUNTING & PAYMENT OF COSTS

Utilities must bill for utility and arranged loans (if lender agrees). Bills must show all RCS charges (including loans) individually on a bill or on a separate bill. Customer can pay both charges (i.e., RCS improvements and utility bill) with one check.

The repayment of loans for RCS improvements must provide for a period of not less than three (3) years, with a minimum monthly payment of $5.00. There can be no service termination for default or penalty for prepayment of this type of loan.

Allowable utility financing: the utility can finance any energy measure covered by law up to $300 with the exception of furnace efficiency modifications, clock thermostats, and load management devices. If a waiver is granted by DOE, loans over $300 can be made. Also, if there was a pre-NECPA state loan program authorized, loans over $300 can be made.

Costs that must be expensed to all ratepayers are: program announcement; public education; and program promotion. Costs that must be charged to the customer receiving the service are: labor and material connected with purchase or installation measures;

and interest cost of loans.

Any state plan must contain information on procedures for accounting, payment of costs, and billing.

COMPLAINT PROCEDURES

Each plan must contain procedures which provide free to consumers a complaint resolution system which includes redress procedures and the offer to conduct a conciliation conference. Enforcement of these procedures is to be specified in the plan. This section is covered in detail on page 64675, Section 456.3.5 in the Wednesday, November 7, 1979 Federal Register.

POST-INSTALLATION INSPECTIONS

States will enforce the 100% mandatory inspection of vent dampers, electric ignition systems, and wind energy systems. There should be at least one inspection for every listed contractor who installs a measure during the life of the program. If this inspection uncovers a violation, another inspection of that contractor's work is required.

States must set procedures for random inspections of ceiling insulation, floor insulation, wall insulation, solar water heating, and active solar space heating. At least four of a contractor's first ten installations for each measure must be inspected, ten percent of all installations thereafter.

Energy Conservation Measures covered by the RCS plan are: caulking and weatherstripping; replacement central air conditioners (high efficiency); ceiling, wall, and floor insulation; duct and pipe insulation; water heater insulation; storm (or thermal) windows and doors; heat-reflective and heat-absorbing windows and doors; load management devices; clock thermostats; and furnace efficiency modifications, including replacement furnaces or boilers (same fuel), furnace replacement burners (oil), flue opening modifications (gas), and electrical or mechanical ignition systems.

Renewable Resource Materials covered by the plan are: solar domestic hot water systems; active solar space heating systems; combined active solar space heating and solar domestic hot water system; passive solar space heating and cooling systems, including direct gain glazing systems, indirect gain systems, solaria/sunspace systems, and window heat gain retardants; wind energy devices; and replacement solar swimming pool heaters.

RCS Measures Eligible for Federal Income Tax Credits under the Energy Tax Act of 1978 are: wall, ceiling, and floor insulation; pipe and duct insulation; water heater insulation; caulking and weatherstripping; vent dampers; electric ignition systems; storm or thermal windows and doors; clock thermostats; and solar and wind energy systems.

APPENDIX J

RESIDENTIAL CONSERVATION SERVICE PROGRAM

BOOK TWO - INSTALLATION PRACTICES FOR ENERGY CONSERVING MATERIALS

PART A - INSTALLATION OF LOOSE-FILL THERMAL INSULATION

Residential Conservation Service Program
U.S. Department of Energy
and
National Bureau of Standards
U.S. Department of Commerce

April 11, 1980

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INTRODUCTION

This publication is intended to provide technical assistance to personnel participating in the Residential Conservation Service. It consists of two books and the following subparts:

BOOK ONE: INTRODUCTION

- PREFACE
- THE RESIDENTIAL CONSERVATION SERVICE
- TECHNICAL ISSUES
- DIAGNOSTIC TOOLS
- PRODUCT CERTIFICATION
- REFERENCES

BOOK TWO: INSTALLATION PRACTICES

- PART A - INSTALLATION OF LOOSE-FILL THERMAL INSULATION
- PART B - INSTALLATION OF BATTS AND BLANKET THERMAL INSULATION
- PART C - INSTALLATION OF RIGID BOARD THERMAL INSULATION
- PART D - INSTALLATION OF REFLECTIVE INSULATION
- PART E - INSTALLATION OF STORM WINDOWS, THERMAL, WINDOWS, MULTI-GLAZING UNITS, AND STORM AND THERMAL DOORS
- PART F - INSTALLATION OF INSULATION ON GAS-FIRED, OIL-FIRED, AND ELECTRIC RESISTANCE WATER HEATERS
- PART G - INSTALLATION OF REPLACEMENT OIL BURNERS

The publication is designed as a guide for state energy offices, RCS implementing agencies, participating utilities and energy suppliers, and RCS field personnel including auditors, installers, and inspectors. For this reason, both Books One and Two, and the sub-parts associated with energy conserving measures can be easily separated, reproduced, and distributed to appropriate parties without losing continuity of the intended purpose or the rest of the publication. Book One serves as a source of detailed specific information on significant technical issues which are common to the measures, and it is cross-referenced from the other sub-parts. Book Two provides detail sufficient for most installations, including both the Final RCS Rule and descriptions or explanations of each provision where necessary.

In Book Two, a standard convention is used to separate the Rule requirements from suggested recommendations or notes. Throughout the sub-parts, the Rule provisions are not indented, as are notes and recommendations. (In the final version of this publication, the Rule provisions will be bold-face type.)

I. SCOPE

This practice covers the installation of dry organic (cellulosic or wood) and mineral (rock, slag, or glass) fiber loose-fill thermal insulation on ceilings, attics, floors and in frame wall cavities, and mineral cellular (perlite or vermiculite) loose-fill thermal insulation in attic floors and various masonry wall cavities of existing residential buildings of four units or less.

This practice:

- Applies only to the installation of dry loose-fill thermal insulation consisting of organic or mineral materials by blowing or pouring. It does not apply to material installed in a wet condition or where liquid is added at any stage of the installation process.
- Covers the installation process from pre-installation procedures through post-installation procedures. It does not cover the production of the insulation materials, whether such production takes place in a factory or at the installation site.
- Describes, in general terms, the procedures to follow so that a safe and effective installation is assured. It does not describe in detail the terminology and fundamentals of residential construction, or the codes or regulations that may be imposed by other federal, state, or local agencies. A working knowledge of the terminology and fundamentals of construction, and applicable codes is necessary for the proper application of this standard.
- Covers aspects of installation relating to the effectiveness, durability, and safety of insulation in service. It does not address the safety of the person(s) installing the insulation.
- Provides minimum requirements that will help to ensure the installation of insulation in a safe and effective manner. Actual conditions in buildings vary greatly and in some cases substantial additional care and precaution may have to be taken to ensure effective and safe installation.

- Intended to establish a minimum level of performance for safety and effectiveness. When a manufacturer's installation instructions regarding specific requirements that affect safety and effectiveness result in a higher level of performance for these characteristics, such manufacturer's installation instructions may be used.

- Is not intended to supersede the authority of state and local codes but is instead intended to establish minimum criteria for safety and effectiveness. When state or local codes specifically address the substance of provisions contained therein, they may apply; when state and local codes do not address the substance of specific provisions contained therein, this practice shall prevail.

II. SIGNIFICANCE

This practice recognizes that effectiveness, safety, and durability of insulation depend not only on the quality of the insulating materials, but also on their proper and workmanlike installation.

Improper installation of insulation may reduce its thermal effectiveness, cause fire hazards and other unsafe conditions, and promote the deterioration of the structure in which it is installed.

Specific hazards that can result from improper installation include:

- Fire caused by heat buildup from recessed lighting fixtures covered by insulation;
- Flame spread on exposed flammable vapor barriers;
- Deterioration of wood structures, paint failures, and corrosion of metal fasteners and electrical components caused by prolonged moisture accumulation within building components; and
- Deterioration or failure of electrical wiring components and heat buildup caused by overfused electrical circuits or by exposed metal wire conductors, when wiring is encapsulated in thermal insulation.

III. DEFINITIONS

Some terms used in describing this practice are as follows:

"Approved" - in this publication, means acceptable to whatever authority regulates the activity or material and its use. Such authority is usually a municipal, state, or federal agency or underwriters' inspection or rating bureau.

"Conditioned Space" - any space in a residential building which is served by a heating or cooling system.

"Mineral Cellular Loose-Fill Thermal Insulating Materials" - (such as Perlite or Vermiculite)* mineral particulate material in granular, modular, powdery, or similar form designed to be installed dry by pouring, blowing, or hand placement between retaining surfaces or as a covering layer.

"Mineral Fiber Loose-Fill Thermal Insulating Materials" - (such as Fiberglass or Rock Wool)* insulation composed of mineral substances such as slag, rock, or glass suitable for pneumatic or poured application.

"Organic Loose-Fill Thermal Insulating Materials" -(such as Cellulose or wood fiber)* thermal insulation composed of chemically treated cellulosic or wood fibers, or any combination thereof suitable for pneumatic or poured application.

"Unconditioned Space" - any space, out-of-doors or in a residential building, which is not served by a heating or cooling system.

"Vapor Barrier" - any material [as defined in ASTM C755-73] that has a water vapor permeance [perm] rating of one (1) or less.

The following materials, upon proper application, constitute vapor barriers. Asphalt impregnated kraft paper, aluminum foil, plastic film, and paint and wallcoverings which are labeled by the manufacturer as having a perm rating of one (1) or less when applied in accordance with the manufacturer's instructions.

The use of a trade name does not connotate recommendation, but simply indicates commonly recognized generic types of materials.

IV. MATERIALS

This practice applies to the installation of loose-fill cellulosic or wood fiber, mineral (rock, slag, or glass) fiber, and mineral cellular (Perlite and Vermiculite) thermal insulation, suitable for pneumatic or poured application. Table 1 gives some of the more important material characteristics covered under this practice.

Under the RCS, all loose-fill insulation installed must meet the applicable DOE material standards for loose-fill cellulosic or wood fiber thermal insulation, loose-fill mineral fiber thermal insulation, vermiculite thermal insulation, or perlite thermal insulation.

Each container of insulation used must bear the marking "Conforms to DOE Standards." This marking indicates that the manufacturer certifies the product meets the applicable DOE standards. The label does not imply that DOE has conducted tests on the material or that the manufacturer uses an approved quality assurance program.

It is recommended that all insulation materials installed in residential buildings be tested by a NVLAP accredited laboratory and have third party certification. (See Book One, page ___ for further discussion.)

TABLE 1. MATERIAL CHARACTERISTICS

Material Type	Mineral Fiber Loose-Fill		Organic Loose-Fill	Mineral Cellular Loose-Fill	
Common Name	Fiberglass	Rock Wool	Cellulose	Perlite	Vermiculite
"R" Valve/Inch*	2.2	2.9	3.2 to 3.7	2.5 - 3.7	2.4 - 3.0
Location of Application	Attics, Ceilings Attic Floors Frame Wall Cavities		Attics, Ceilings Attic Floors Frame Wall Cavities	Attic Floors Masonry Wall Cavities	
Method of Application	Blown or Poured		Blown or Poured	Usually Poured	
Fire Safety: Physical Characteristics	Some are non-combustible per ASTM E 136		Combustible per ASTM E 136; Treated with fire-retardant chemicals	Non-combustible per ASTM E 136	
Fire Safety: Restrictions	None		Avoid placement near heat sources, even if treated	None	
Moisture Absorption	<1% by weight	2% by weight	5 - 20% by weight	Negligible	None
Density: Weight/Volume	0.6 - 1.0 lb/ft^3	1.5 - 2.5 lb/ft^3	2.2 - 3.0 lb/ft^3	2 - 11 lb/ft^3	4 - 10 lb/ft^3

**Source: U.S. Department of Energy, An Assessment of Thermal Insulation and Systems for Building Applications, June 1978. These "R" Values are common averages; some manufacturers' materials may exceed these values.*

V. SAFETY PRECAUTIONS

During installation, do not smoke in the attic or any truck or van used for installation.

> Sparks from cigarettes and other smoking materials, and discarded matches have ignited flammable materials (such as vapor barriers and stored materials) in attics. Sparks that drop into the hopper of insulation blowing equipment on trucks or vans may be conveyed into attics, causing fires.

It is recommended that prior to installing loose-fill insulation in a building, it be ascertained that all electrical circuits have correct overcurrent protection.

> Electrical wires under normal operating current experience elevated temperatures when surrounded by thermal insulation. If, because of incorrect overcurrent protection (over-fused), such surrounded wires are permitted to carry excessive current, dangerously high temperatures can be reached. (See Book One, page ____ for further discussion).

VI. PRE-INSTALLATION PROCEDURES

GENERAL

Pre-installation inspection is necessary to identify any potential safety hazards in the building and to assure that the installation can be performed effectively and without substantially decreasing the safety or durability of the structure. Certain precautions and preliminary steps must be taken so that the installation can be performed as prescribed in the Installation Procedures section.

Identify all recessed lighting fixtures (including wiring compartments and ballasts) furnaces, vents, chimneys, and other heat-producing devices in all areas where insulation is to be installed so that adequate clearances from combustible materials and insulation can be provided.

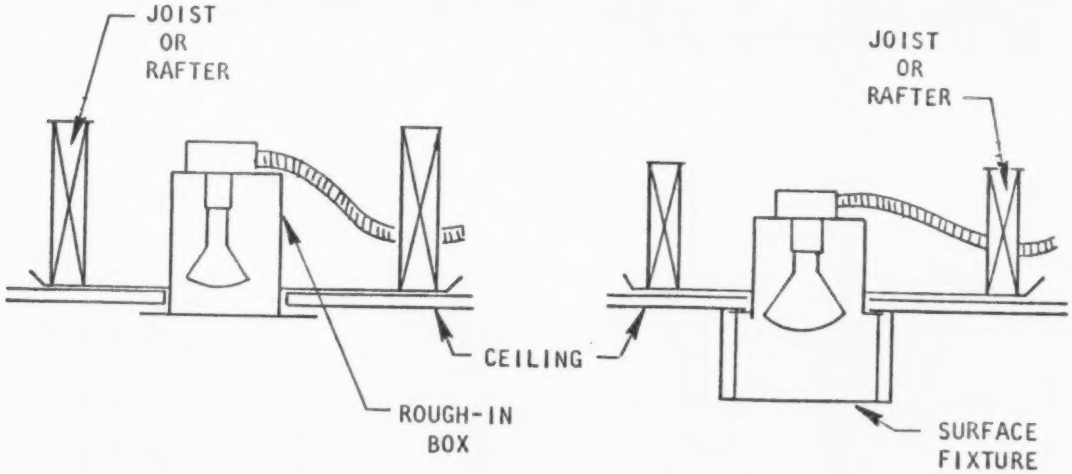

Figure 1. Recessed and Semi-recessed Lighting Fixtures

Install blocking, such as wood, metal or unfaced mineral fiber batts around all heat producing devices to permanently maintain the clearances specified in paragraphs 1.3 through 1.5. Install all blocking at least as high as the height of the finished insulation and in a manner that ensures that all devices which may require maintenance or servicing remain accessible after the insulation is installed.

Install blocking to provide a three-inch minimum clearance around all recessed lighting fixtures (including associated wiring compartments and ballasts) and other heat producing devices not covered in paragraph 1.4. Do not cover these devices so as to entrap heat or prevent the free circulation of air unless they are approved for the purpose.

> This requirement is based on section 410-66 of the National Electrical Code (NFPA-70). Recessed lighting fixtures rely on the free movement of air around and above them to dissipate the heat generated by the bulbs, ballasts, and wiring compartments. Even if the insulation material itself is non-combustible, if it is installed above or around a recessed lighting fixture, temperatures within the fixture may become sufficient to ignite fixture components and surrounding framing members.

Install blocking around gas-fired appliances to provide the minimum clearances specified in NFPA-54, the National Fuel Gas Code. Install blocking around oil-fired appliances to provide the minimum clearances specified in NFPA-31, Standard for the Installation of Oil Burning Equipment. Install blocking around masonry chimneys or masonry enclosing a flue to provide a minimum two-inch (50 mm) clearance from the outside face of the masonry. Install blocking around vents, chimney and vent connectors, and chimneys other than masonry chimneys to provide the minimum clearances specified in NFPA-211, Standard for Chimneys, Fireplaces, and Vents. (The applicable provisions of NFPA-54, -31, and -211, are reproduced in Book Three.)

When installing mineral fiber or mineral cellular insulation which, in addition to meeting all the requirements specified in DOE Material Standards, is also non-combustible as defined in ASTM E 136-79, the blocking and airspaces around vents and chimneys need not be provided.

> Do not assume that the material being installed is non-combustible unless the label specifically states that the product meets the combustibility requirements of ASTM E 136-79.

Inspect areas to be insulated and identify areas of previous moisture problems such as paint peeling, warping, stains, fungus growth, rotting, and any excessive corrosion (rust) on metal fasteners and electrical components. Do not install insulation in the immediate area of such evidence of previous moisture problem unless the cause of the problem has been identified and eliminated.

Installing insulation in an area which exposes it to moisture may contribute to further deterioration of the structure and loss of effectiveness of the insulation. Insulation in such areas may prolong exposure of components to moisture creating a potential for fungus growth, rotting, and leaching of boric acid used as a fire-retardant in some types of loose-fill insulation. DOE recommends against installing insulation in such areas, however, the ultimate decision rests with the homeowner.

Under the RCS program, the homeowner must be informed of the moisture problem and give written consent in the contract to proceed with the insulation despite the unidentified and uncorrected condition.

In evaluating whether or not the cause of an apparent previous moisture problem has been eliminated and what steps need to be taken to correct any remaining deficiencies, the type of moisture problem needs to be identified. The three primary types are rainwater leakage, leaking or burst pipe, and condensation. For specifics in identifying moisture problems, see Book One, p. ____.

If it is determined that remedial action is not feasible, too costly, or simply not desired by the homeowner, no insulation should be installed in the immediate area of the moisture damage. Immediate area is defined as the stud or joist space(s) in which prior moisture problems were observed.

Block all openings in ceilings, floors, and sidewalls through which the insulating material may escape. Seal all wall cavities which open into a basement or crawl space before wall insulation is installed.

It is especially important to ensure that all wall cavities are sealed properly in homes of a balloon frame construction since open ended cavities are inherent in this type of design.

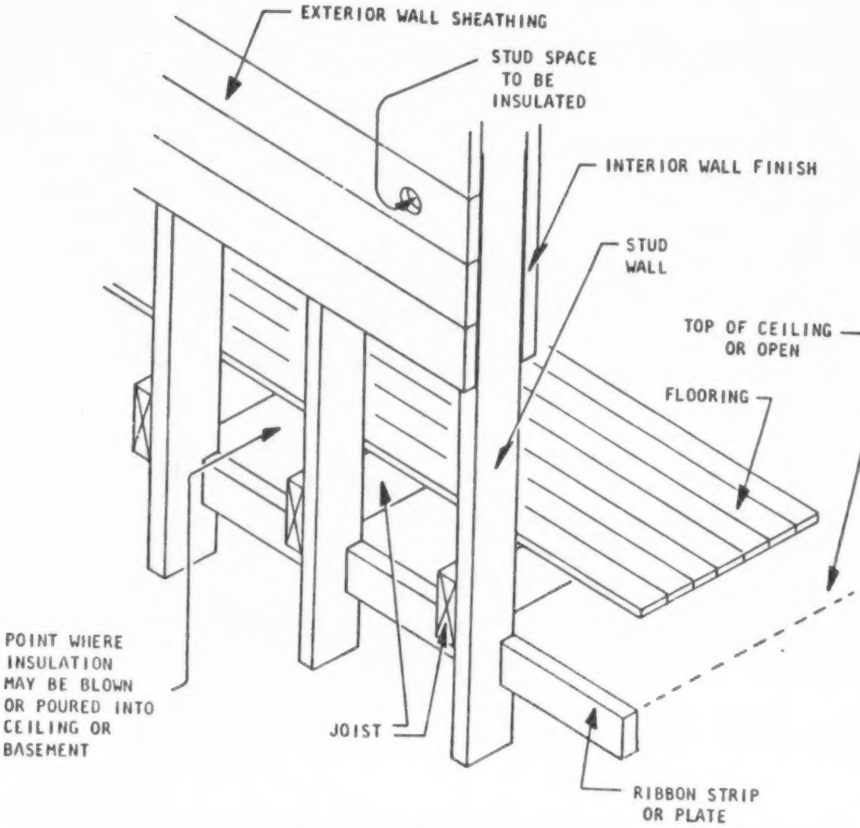
EXTERIOR WALL SHEATHING
STUD SPACE TO BE INSULATED
INTERIOR WALL FINISH
STUD WALL
TOP OF CEILING OR OPEN
FLOORING
POINT WHERE INSULATION MAY BE BLOWN OR POURED INTO CEILING OR BASEMENT
JOIST
RIBBON STRIP OR PLATE

Figure 2. Balloon Framing

WALLS

For buildings located in Zone I of Figure 3, provide a vapor barrier on the interior surface of all walls to be insulated in bathrooms and unvented kitchens and laundry areas. Caulk or seal all major cracks on the interior face of exterior walls of these rooms including joints between the floor and wall (except where impractical because of carpeting), between wall and ceiling, at joints around window frames, and around wall penetrations for electrical services (outlets and switches) and plumbing stacks, and heating and air-conditioning ducts. These openings provide a major access for moisture transport into wall cavities.

Examples of appropriate vapor barrier materials are given on page ___.

It is recommended that a vapor barrier and caulking, such as described in this section, also be provided on all walls to be insulated in bathrooms and unvented

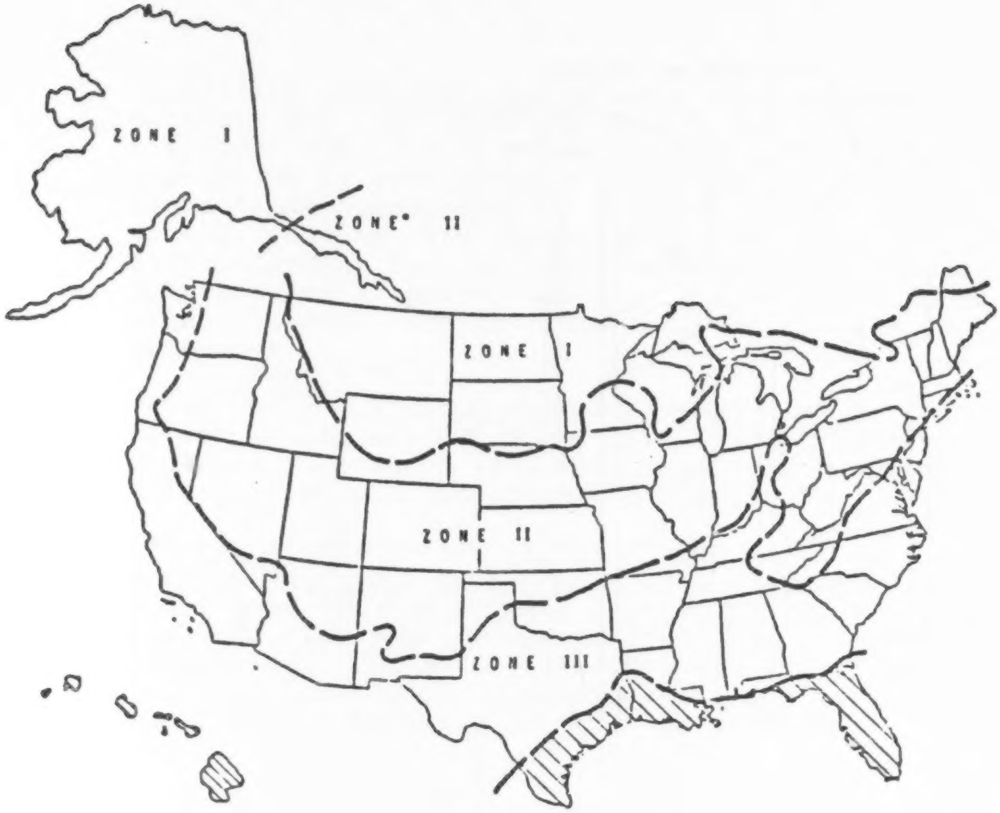
ZONE I
ZONE* II
ZONE I
ZONE II
ZONE III

Figure 3. Condensation Zones in the United States

ASHRAE HANDBOOK AND PRODUCT DIRECTORY - 1977 FUNDAMENTALS, Page 20.9

kitchens and laundry areas in buildings in Zone II of Figure 3.

The above requirements for moisture control are minimum requirements needed to prevent long term moisture damage. Homes which are characterized by one or more of the following conditions are more likely to experience excessive moisture accumulation which can be corrected by application of a vapor barrier and caulking as described above and/or additional venting of the wall cavity from the exterior or additional ventilation of the occupied space:

a. Homes with an area of less than 800 square feet (75 square meters);

b. Homes with less than 250 square feet (23 square meters) per occupant;

c. Homes with tight wall and ceiling construction and weatherstripped windows and doors;

d. Electrically heated homes or homes with a heating system which uses outside combustion air; and

e. Homes that are humidified during the winter.

These homes are more likely to experience moisture accumulation either because they have reduced air exchange rates (c,d), have lower surface areas per person through which moisture can dissipate (a,b), or are humidified beyond the capability of the structure to dissipate the moisture being introduced artificially (e).

A relative humidity indicator may be installed to monitor the humidity level and determine when excessive moisture accumulation is likely to occur. Additional information on the use of a humidity indicator is described in Book One, page ____.

Frequent occurence of condensation on double-glazed window panes is another indication of excessive indoor humidity.

Further information on condensation and moisture problems can be found in Book One under Moisture Protection.

ATTICS AND CEILINGS

Identify and measure ventilation area in attics. Do not install insulation in attics unless ventilation openings in attic areas conform to one of the following requirements:

> 1 ft^2 (0.1 m^2) minimum of free ventilation area per 150 ft^2 (15 m^2) of attic floor area, if no vapor barrier exists in the attic;
>
> 1 ft^2 (0.1 m^2) minimum of free ventilation area per 300 ft^2 (30 m^2) of attic floor area if a vapor barrier does exist;
>
> 1 ft^2 (0.1 m^2) minimum of free ventilation area per 300 ft^2 (30 m^2) of attic floor space if at least 50 percent of the required ventilating area is provided with fixed ventilation located in the upper portion of the space to be ventilated [at least three feet (900 mm) above eave or soffit vents] with the remainder of the required ventilation provided by eave or soffit vents, if no vapor barrier exists.

If the free ventilation area of louvers is not known, assume that it is half of the area of the ventilation opening and increase the opening accordingly. Many louvers have their free ventilation area stamped on their frames.

Ensure that all ventilation openings have suitable louvers or screens to prevent rain or snow from entering the attic.

> Adequate attic ventilation is necessary to carry to the outdoors any moisture that enters the attic from the house. More ventilation area needs to be provided in homes which do not have a vapor barrier on the attic floor or ceiling surface which has no vapor barrier because more moisture can be transmitted through a ceiling, both summer and winter. Where the location of attic vents is such that efficient air currents for ventilation will result, the ventilation requirements can be lower even where no vapor barrier exists.

For buildings located in Zone I of Figure 3, if there is no existing insulation or if existing insulation is to be removed, provide a vapor barrier membrane on the upper surface of the ceiling material. Never install a vapor barrier on top of existing insulation, as the vapor barrier may trap moisture in the insulation and construction members. This may promote deterioration of the structure, and may result in reduced resistance (R-value) for the insulation.

For buildings in Zones I and II of Figure 3, where there is existing ceiling insulation and no vapor barrier, it is recommended that a vapor barrier such as paints and wall coverings which are labeled by the manufacturer as having a perm rating of one (1) or less and are applied in strict accordance with the manufacturer's instructions be installed on the interior ceiling surface of bathrooms and unvented kitchens and laundry areas. It is also recommended that all cracks and penetrations on the interior ceiling surface of these rooms (such as around lighting fixtures and at wall and ceiling joints) be caulked.

Examples of appropriate vapor barrier materials are given on page ___.

The above requirements for ventilation and moisture control are minimum requirements needed to prevent long term moisture damage. Refer to the note under Walls above and Book One, page ___ for additional information and steps to be taken to control moisture damage.

Install permanent blocking around attic trap doors and bathroom, kitchen, and laundry vents which open into the attic, if the level to which the insulation will be installed exceeds their height. Ensure that the blocking is installed around vent openings in a manner that enables the free movement of air through the vent into the attic.

The venting of bathroom and kitchen air into the attic is an undesirable building practice because it introduces excessive moisture into the attic which may condense when exposed to the cooler temperatures there. The potential for condensation is further increased as insulation is added because the insulation reduces the rate of flow of heat from the living area to the attic, causing attic temperatures to be even lower. It is therefore recommended that these vents as well as clothes dryer vents which open into the attic be extended to allow venting outside.

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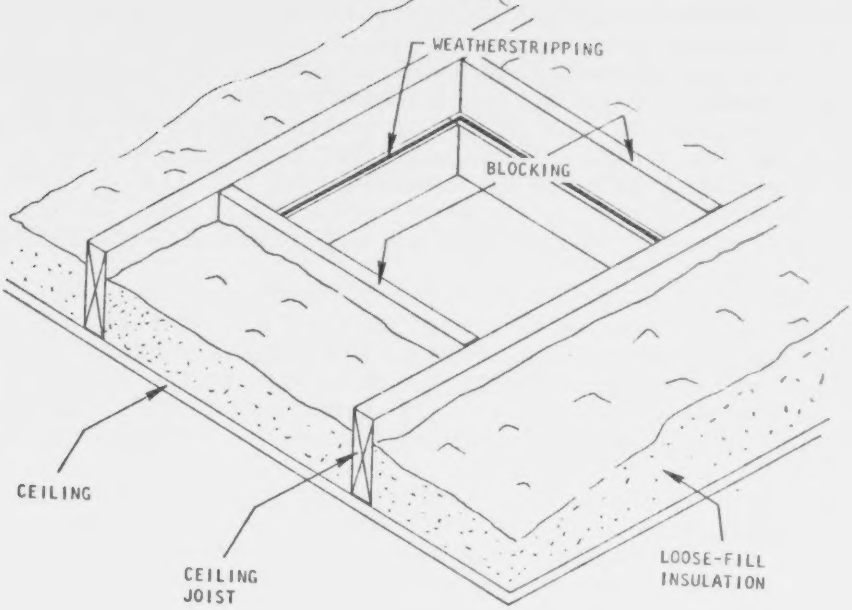
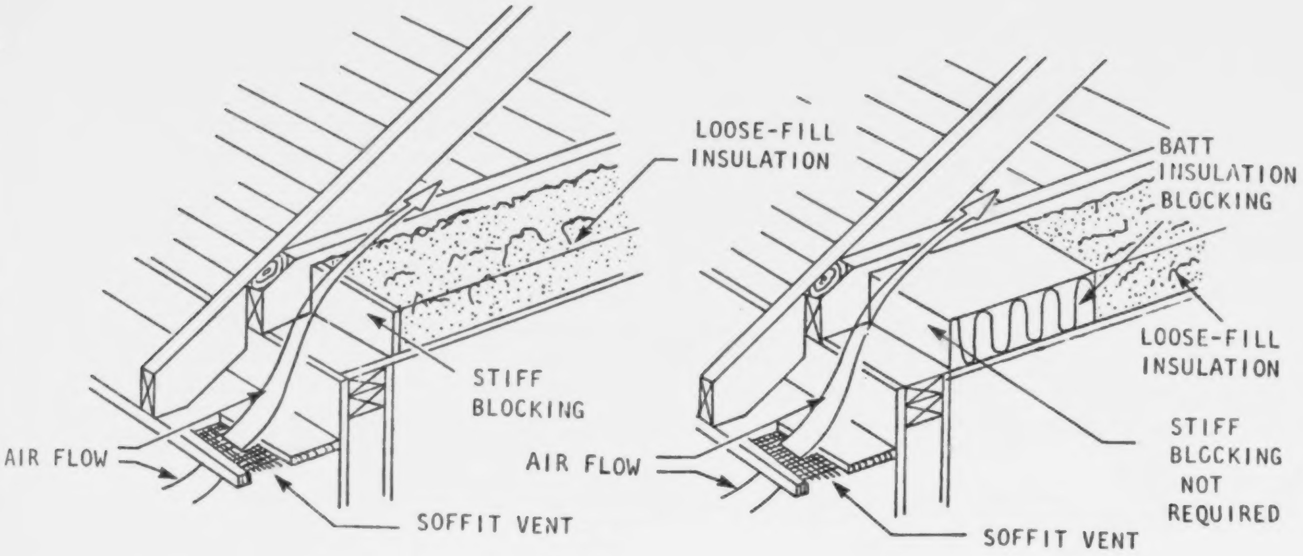

WEATHERSTRIPPING
BLOCKING
CEILING
CEILING JOIST
LOOSE-FILL INSULATION

Figure 4. Blocking Around Trap Doors and Vents

Cover all bathroom and kitchen vent openings in the attic with temporary blockings prior to the installation of insulation to assure that no insulation material falls into the vents.

Install permanent blocking to restrain loose-fill insulation from clogging soffit vents and restricting attic ventilation. Install blocking so as to ensure free movement of air through soffit vents into the attic. Methods of blocking are shown below.


LOOSE-FILL INSULATION
STIFF BLOCKING
AIR FLOW
SOFFIT VENT
BATT INSULATION BLOCKING
LOOSE-FILL INSULATION
STIFF BLOCKING NOT REQUIRED
AIR FLOW
SOFFIT VENT

(a) Using rigid blocking (b) Using batt insulation

Figure 5. Preventing Blockage of Soffit Vents

It is recommended that all penetrations around vertical chases extending into attics be sealed. Where the chase holds a chimney or pre-fabricated flue, the material used to block or seal the opening must be non-combustible in conformance with ASTM E-136. The conditions are shown on Figure 6 below.

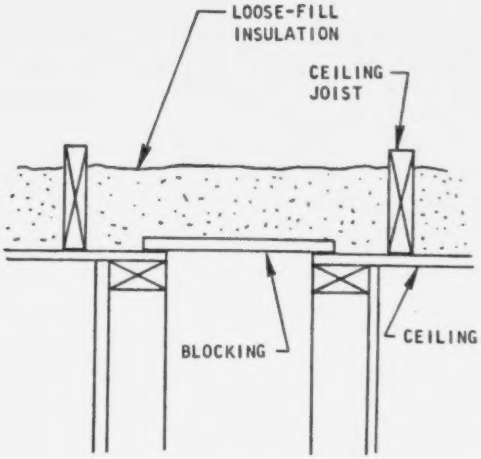

LOOSE-FILL INSULATION
CEILING JOIST
BLOCKING
CEILING

Figure 6. Blocking and Sealing Mechanical Chases

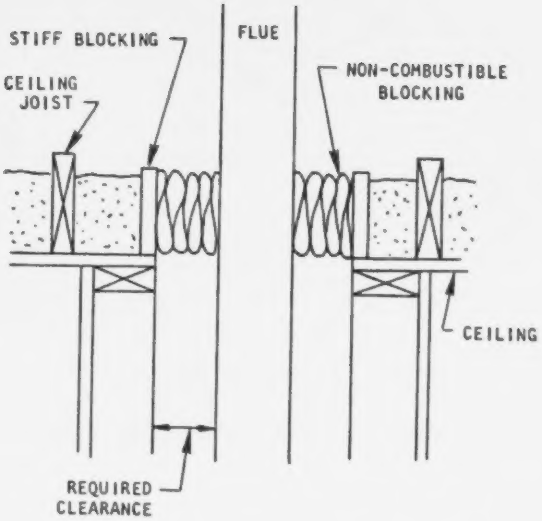

STIFF BLOCKING
FLUE
CEILING JOIST
NON-COMBUSTIBLE BLOCKING
CEILING
REQUIRED CLEARANCE

Figure 7. Blocking and Sealing Around Flues

VII. INSTALLATION PROCEDURES

GENERAL

Do not install insulation unless the pre-installation procedures have been carried out and any defects which were identified were corrected and their causes eliminated.

> This is necessary for safe and effective installations. Specific reasons for this are discussed in the previous section on Pre-installation Procedures.

Structural damage can be caused by excessive pressures during the installation or can result from installing insulation in constructions too weak to support the imposed load. Install insulation only so as not to cause any of the following conditions:

- Separation of finish materials from joists or studs.
- Cracking of materials or opening of joints between boards.
- Deflection of more than 1/200 of the joist or stud spacing.

  The following table, which is based on tests and other data submitted by gypsum board manufacturers, may be used to determine whether a gypsum board surface is likely to exceed the maximum allowable deflection specified above. Actual deflection or other failure in service depends on various factors such as:

  - Whether the gypsum board is installed with its long side parallel or at right angles to the joists.
  - Relative humidity.
  - Temperature conditions.

TABLE 1. MAXIMUM SUGGESTED LOADS

(1) Gypsum board ceiling thickness	(2) Frame spacing	(3) Suggested load*
1/2 in.	24 in. o.c.	1.3 psf
1/2 in.	16 in. o.c.	2.2 psf
5/8 in.	24 in. o.c.	2.2 psf

*Includes the weight of both the new and any existing insulation.

Handle all insulation material in accordance with manufacturer's instructions and keep it dry and free of extraneous materials.

> This protects the physical condition and thermal effectiveness of the insulation.

For pneumatic installation use only equipment compatible with the insulation material and operate the equipment in accordance with the manufacturer's instructions.

> Insulation materials derive their insulating characteristics from the air spaces which are created in the material. Each insulation manufacturer identifies on the product label the density at which the material should be installed to maximize the thermal insulating characteristics of that particular material. The density at which the material is installed is determined by the air flow rate of the installation equipment. It is therefore important to use equipment which is compatible with the type of material being installed and to operate the equipment in accordance with the manufacturer's instructions. The installation equipment should always be set to deliver the insulation at the density specified by the insulation manufacturer.

Install insulation so that it will not be in contact with the ground or moist areas.

> This ensures that insulation does not become wet, lose its thermal effectiveness, or promote fungus growth.

Install insulation only between conditioned interior living areas and unconditioned spaces (such as unheated attics, basements, garages, utility rooms, and the outdoors).

> Insulation between separately conditioned living areas is not recommended because the temperature differential between these spaces is insufficient to offset the cost of the insulation. Partitions between conditioned spaces are sometimes insulated to decrease sound (acoustic) transfer. However, such applications do not conserve energy.

WALLS

Do not fill wall cavities which themselves are air ducts for heating, ventilation, and/or cooling systems.

Locate and open entry holes in walls (if required) to permit the complete filling of wall cavities.

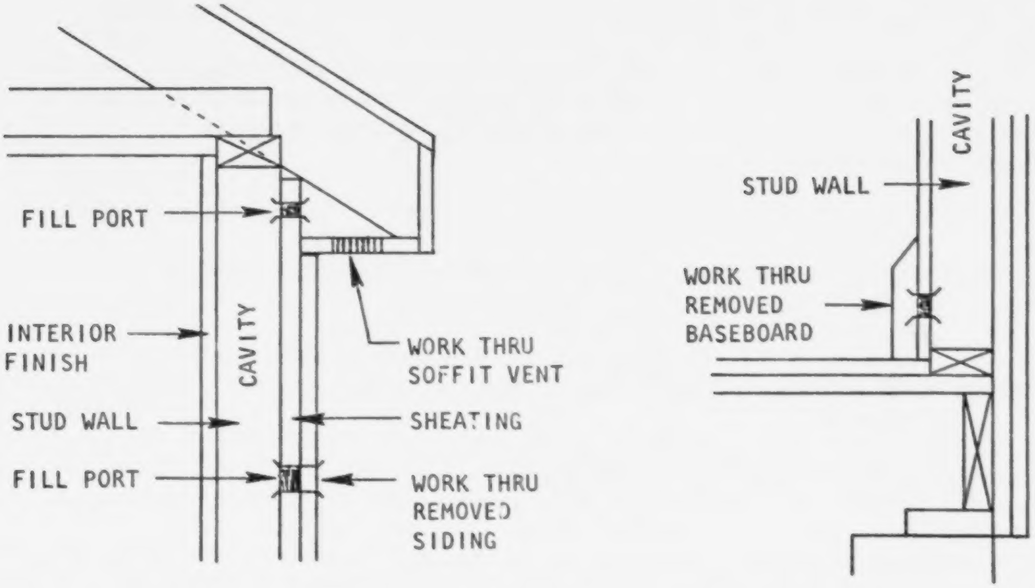
> A minimum of two openings per floor per stud space is recommended. The lower port should be no further than 4 feet from the bottom of the wall and the upper port no further than 1-1/2 feet from the top of the wall. The number of holes required is based on the density of the material and its capability to flow within the wall during application. Follow the material manufacturer's recommendations for the number and location of entry holes. Points of entry in a typical wall are shown in Figures 8, 9, and 10. Some construction types may not require the drilling of entry holes to gain access to every cavity. It may be possible to gain access through eaves or overhang panels. In balloon construction, access may be gained from the attic.

After the entry holes have been opened, use them to check the wall cavity for fire stops and other obstructions which will necessitate additional entry holes to assure complete filling of the cavity.

> One method of probing the cavity is to insert a stiff piece of wire or plumb line to determine the location of internal obstructions.

With the exception of spaces identified in the Pre-installation inspection, completely fill wall cavities in accordance with the insulation manufacturer's recommendations.

> Follow the manufacturer's recommendations for air pressure and density. Keep a record of the number of bags used to ensure the installed insulation conforms to the manufacturer's recommended coverage shown on the material label.


FILL PORT
INTERIOR FINISH
CAVITY
STUD WALL
FILL PORT
WORK THRU SOFFIT VENT
SHEATING
WORK THRU REMOVED SIDING
CAVITY
STUD WALL
WORK THRU REMOVED BASEBOARD

(a) Top of the Wall (b) Bottom of the Wall

Figure 8. Alternate Points of Entry for Fill Tube in Sided Construction

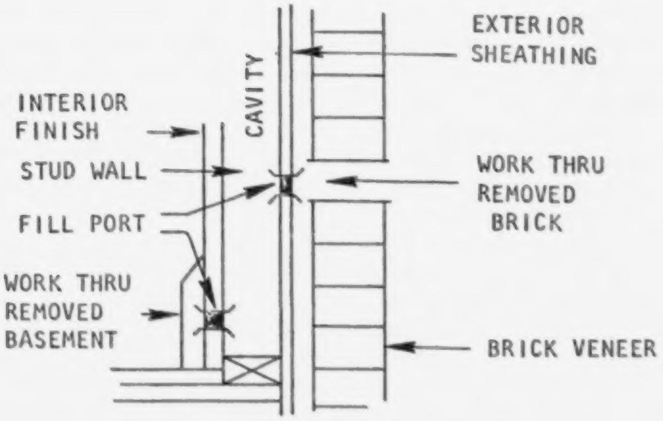

EXTERIOR SHEATHING
CAVITY
INTERIOR FINISH
STUD WALL
FILL PORT
WORK THRU REMOVED BRICK
WORK THRU REMOVED BASEMENT
BRICK VENEER

Figure 9. Alternate Points of Entry for Fill Tube in Brick-Veneer Construction

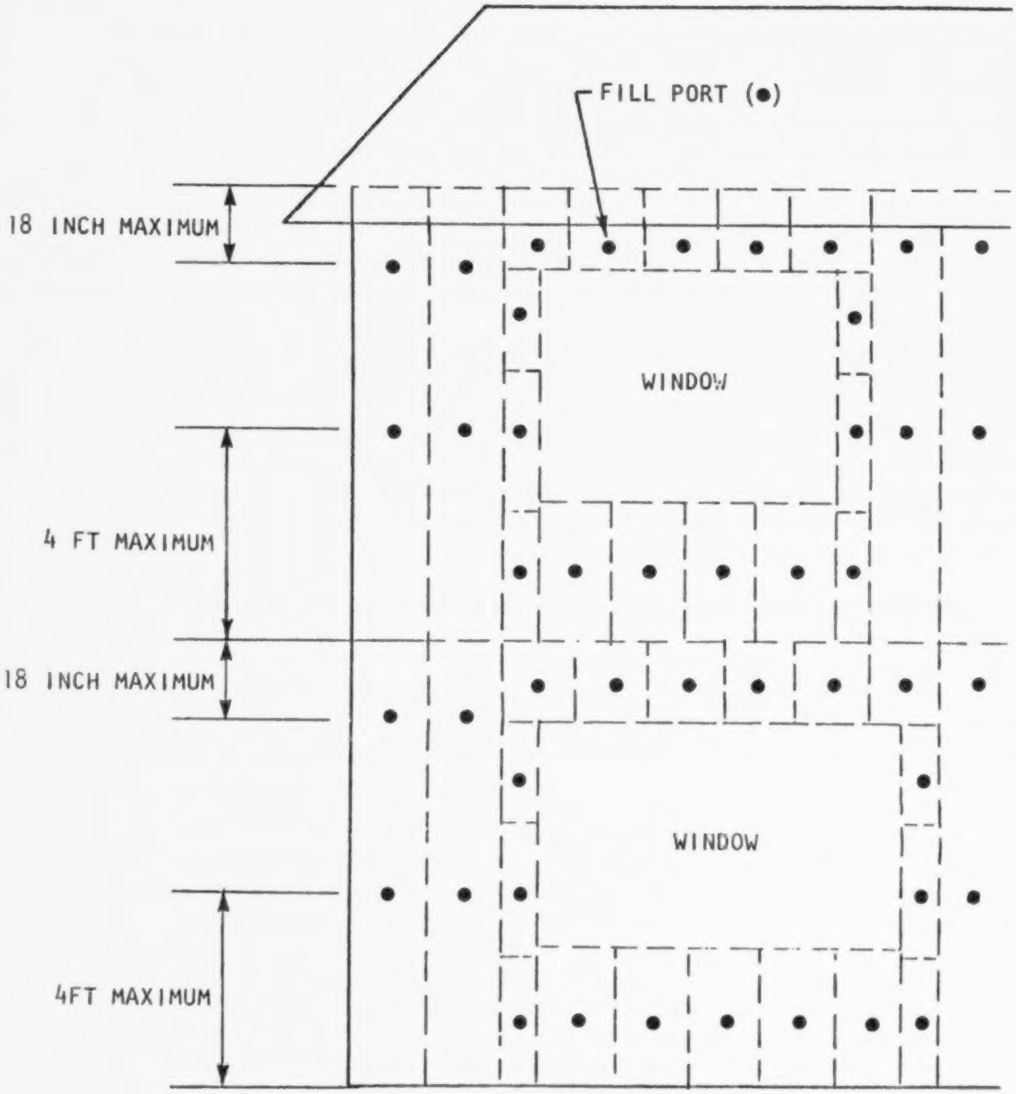

FILL PORT (●)
18 INCH MAXIMUM
4 FT MAXIMUM
18 INCH MAXIMUM
4FT MAXIMUM
WINDOW
WINDOW

Figure 10. Typical Layout of Fill Ports

Close all entry holes in a workmanlike manner using materials compatible with the original materials. Do not close entry holes in sheathing which is covered by an exterior brick veneer or siding.

> It is not necessary to seal entry holes in sheathing if the exterior finish will protect the area from water leakage. It is, in fact, desirable to leave these open to enable additional ventilation of the cavity ensuring that no moisture accumulation occurs.

ATTICS AND CEILINGS

For pneumatic installation in ceiling areas, use the least air pressure meeting the manufacturer's instructions.

> Follow the manufacturer's instructions for spread rate and install the insulation to a uniform depth at the recommended installed settled density for the R-value to be installed. The correct density and application rate is shown on the bag label. Keep a record of the number of bags used to ensure the installed insulation conforms to the manufacturer's recommended coverage shown on the material label.

Do not blow insulation into electrical devices or into vents which open into the attic or areas that have been blocked off during the pre-installation procedures.

Fit the attic side of trap doors or panels with insulation batt (or equivalent material) except where prevented by a retractable ladder.

> Secure the insulation in place using staples or other appropriate fasteners. Insulation may be installed to the exterior or trap doors which have retractable ladders mounted on their interior. If the insulation is installed to the exterior of the trap door, a finish material (such as gypsum board) should be provided for both aesthetic reasons and to protect the insulation. Weatherstripping should be installed along the contact edge between the access panel and frame to reduce infiltration losses in this area.

VIII. POST-INSTALLATION PROCEDURES

Inspect the coverage and depth of the insulation. Fill all "pockets" and voids in the insulation. Level insulation in a manner which will not damage wiring or any other items.

> Ensure that the quantity of insulation specified on the bag label to provide the desired R-value for the area to be insulated has been installed. The depth or thickness of the insulation should conform to the information on the bag label.

Turn off electric power and clear all electric wall outlet boxes and switch boxes of any insulation material.

> Electric power shut-down is essential to prevent a potentially dangerous electric shock hazard during the cleaning operation. It is necessary to clear electric boxes to protect the building against possible ignition of materials in the proximity of electrical contacts and to prevent the corrosion of electrical components in contact with chemicals used as fire retardants in certain types of insulation.

Remove all temporary blockings which were installed over vent openings in attics.

> Temporary blockings are those that were provided during the pre-installation procedures over bathroom, kitchen, and laundry vents which open into the attic.
>
> Do not remove any of the blockings that were installed to permanently prevent insulation inundation in vents, heat producing devices, and other areas specified in this practice.

IX. CERTIFICATION REQUIREMENTS

Contractors and Installers are responsible, upon completion of each installation of insulation under the RCS, to complete in triplicate a "Certification of Insulation" form which contains all of the information shown on the sample in Figure 12.

> Because a certificate, such as shown in Figure 12, will ensure that a record of the installation remains available to the homeowner for personal verification, for reference in the consideration of additional energy conserving measures, and for confirmation of energy conserving installations during future sales of the house, it is recommended that the certificate be provided whether or not the installation is done under the RCS. To the degree that the certificate provides assurance that the installation was completed in accordance with the information on the certificate, the certificate will provide confidence in the installation.

The "Certification of Installation" must be distributed and posted as follows:

- One copy must be permanently affixed to the structure in an accessible but inconspicuous location - along with a copy of the R-value chart from the label on the material bag;
- One copy must be submitted to the homeowner or building occupant; and
- One copy must be retained for a period of five years by the agency responsible for the installation.

PART I - GENERAL

ADDRESS OF RESIDENCE:

____

____

DATE OF INSTALLATION COMPLETION: __________

NAME AND ADDRESS OF CONTRACTOR:

____

____

____

PART II - AREAS INSULATED

WALLS (__________sq. ft.)

TYPE OF INSULATION:

____

MANUFACTURER:

____

R VALUE INSTALLED	AMOUNT INSTALLED

CEILINGS (__________sq. ft.)

TYPE OF INSULATION:

____

MANUFACTURER:

____

R VALUE INSTALLED	AMOUNT INSTALLED

FLOORS (__________sq. ft.)

TYPE OF INSULATION:

____

MANUFACTURER:

____

R VALUE INSTALLED	AMOUNT INSTALLED

PART III - CERTIFICATION

I, ______________________ certify that the residence identified in PART I was insulated
(PRINT NAME)
as specified in PART II and the installation was conducted in conformance to applicable codes, standards, and regulations.

____
Authorized Signature

Figure 12. Certification of Insulation

APPENDIX K

Consumer Information Sheets

Prepared by

Intermountain Rural Electric Association
Littleton, Colorado

ENERGY CONSERVATION BULLETINS

Bulletin Subject and Numbers

1. Conservation Measures

1.1.1/2	Buying Insulation
1.2.1	How to Insulate
1.2A.1/2/3/4/5/6/7/8/9/10/11	How to Insulate (Attics)
1.2B.1/2/3/4/5	How to Insulate (Walls)
1.2C.1/2/3/4	How to Insulate (Floors & Basements)
1.2D.1	How to Insulate (Crawl Spaces)
1.3.1	Insulation: R values, performance & safety standards
1.4.1/2/3/4/5	Caulking & Weatherstripping
1.5.1/2/3/4/5	Windows and Doors
1.6.1/2	Ventilation
1.7.1/2	Vapor Barriers
1.10.1/2	Environmental Considerations

2. Heating and Air-Conditioning Measures

2.1.1/2	Electric Heating Systems
2.2.1	Electric Heating: Radiant
2.3.1	Electric Heating: Baseboard
2.4.1	Hot Water Heaters
2.5.1/2	Thermostatic Controls
2.6.1/2	Fireplaces
2.7.1/2/3	Heat Pumps
2.8.1/2	Air Conditioning
2.9.1	Humidity Control
2.10.1	Electric/Propane Cost Comparison

3. Recommended Practices

3.2.1/2/3	Kitchen Appliances
3.3.1/2	Laundry Appliances
3.4.1/2	Other Appliances
3.4A.1	Appliances: Energy Use & Operating Cost
3.4B.1/2	Buying Appliances
3.5.1/2	Lighting
3.6.1/2	Fireplace Use
3.7.1/2	Electric Heating Use

4. Explanations

4.1.1/2	How to Engage a Contractor
4.2.1	Heat Flow
4.3.1/2/3/4/5/6	Residential Demand & Energy Rate
4.4.1/2	Reading & Understanding Utility Bills
4.5.1	Why Conserve
4.6.1/2/3	Frame House Construction

5. New Home Recommendations

5.1.1/2/3/4	New Homes

ENERGY CONSERVATION BULLETIN 1.1.1
Buying Insulation

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

Insulating Materials

Insulation is made from various materials. There is no one type that is best for all applications. They vary according to quality, thermal resistance ("R" value), safety features, dimensions, and where and how they are applied. When choosing materials, these factors should be considered. Described below are the most common materials:

Mineral Fiber — This is made from mineral substances such as rock, slag or glass, and is processed from a molten state into a fibrous form. Most commonly known as "glass fiber" (fiber glass) or "rock wool," it comes as blankets (rolls or batts) or loose fill. Rock wool can also be blown in place.

Cellulose Fiber — This generally comes in loose fill form, and is made from recycled paper or paper stock that has been defibered. It should be treated for fire resistance and other conditions by the manufacturer. It can be poured or blown in place.

Expanded Materials — These include vermiculite and perlite, and they usually come as loose fill. They can be poured into odd-shaped spots or smaller areas. Sometimes, this is a more expensive insulating material, for a given "R" value, than other types.

Foamed Plastic — As polystyrene, polyurethane and urea formaldehyde, these are preformed into boards or blown (foamed) into wall cavities by contractors. Foam insulation can vary considerably in its final properties depending on the operator's skill, how various reactants are mixed, and the time allowed for "curing." Foams possess other properties which may affect their long-term insulating value, such as moisture retention, shrinkage, spontaneous decomposition, and vermin resistance. Foams also burn, producing smoke and poisonous gases such as carbon monoxide. These hazards can be reduced by following the recommended installation procedures for each type of foam. Foam that is properly installed will have a higher insulating value but may be relatively expensive.

Types Of Insulation

Several kinds of insulation are available to homeowners. Kinds that are easily installed by the do-it-yourselfer are batts, blankets, and loose fill. Foamed-in plastic is usually installed by a contractor because special equipment is used. If your house has a flat roof or a mansard roof, or if your attic or basement area is otherwise restricted, installation will be difficult and you may need to hire a contractor.

BLANKETS — glass fiber, rock wool

Where they're used to insulate:
unfinished attic floor
unfinished attic rafters
underside of floors

- best suited for standard joist or rafter spacing of 16" or 24", and space between joists relatively free of obstructions
- cut in sections 15" or 23" wide, 1" to 7" thick in rolls to be cut to length by the installer
- with or without a vapor barrier backing
- a little more difficult to handle than batts because of size
- fire resistant, moisture resistant
- Most batts and blankets have an attached vapor barrier on one side. Many are totally enclosed, with a vapor barrier on one side and a vapor-permeable material on the other.

LOOSE FILL (poured-in) — glass fiber, rock wool, cellulosic fiber, vermiculite, perlite

Where it's used to insulate:
unfinished attic floor

- vapor barrier bought and applied separately
- best suited for non-standard or irregular joist spacing or when space between joists has many obstructions
- glass fiber and rock wool are fire resistant and moisture resistant
- cellulosic fiber chemically treated to be fire resistant and moisture resistant; treatment not yet proven to be heat resistant, may break down in a hot attic; check to be sure that bags indicate material meets Federal Specifications. If they do, they'll be clearly labelled.
- cellulosic fiber has about 30% more insulation value than rock wool for the same installed thickness (this can be important in walls or under attic floors).
- vermiculite is significantly more expensive but can be poured into smaller areas.
- vermiculite and perlite have about the same insulating value.
- all are easy to install.

LOOSE FILL [blown-in] — glass fiber, rock wool, cellulosic fiber

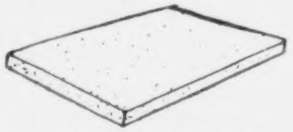
Where it's used to insulate
unfinished attic floor
finished attic floor
finished frame walls
underside of floors

- vapor barrier bought separately
- same physical properties as poured-in loose fill.
- Because it consists of smaller tufts, cellulosic fiber gets into small nooks and corners more consistently than rock wool or glass fiber when blown into closed spaces such as walls or joist spaces.
- When any of these materials are blown into a closed space enough must be blown in to fill the whole space.
- Loose fill which is blown into walls or other inaccessible areas should be installed by a contractor.

RIGID BOARD — extruded polystyrene bead board (expanded polystyrene) urethane board, glass fiber

Where it's used to insulate:

basement wall



NOTE: Polystyrene and urethane rigid board insulation should only be installed by a contractor. They must be covered with ½" gypsum wallboard to assure fire safety.

- extruded polystyrene and urethane are their own vapor barriers, bead board and glass fiber are not.
- high insulating value for relatively small thicknesses, particularly urethane.
- 2 or 4 feet wide by 8 feet long
- variety of thicknesses from ¾" to 4"
- They usually have a higher "R" value per inch of thickness than rolls or batts, and are used as external sheathing and perimeter insulation around foundations, and in new construction in side walls because they give the maximum "R" value for the space. Local fire regulations may prohibit certain types of board insulation, or require that others be fitted by a contractor — ask about this before buying.

BATTS — glass fiber, rock wool

Where they're used to insulate:

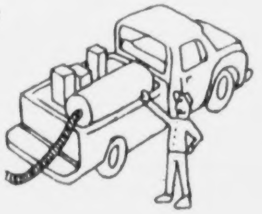
unfinished attic floor
unfinished attic rafters
underside of floors

- best suited for standard joist or rafter spacing of 16" or 24", and space between joists relatively free of obstructions
- cut in sections 15" or 23" wide, 1" to 7" thick, 4' or 8' long
- with or without a vapor barrier backing — if you need one and can't get it, buy polyethylene except that to be used to insulate the underside of floors
- easy to handle because of relatively small size
- use will result in more waste from trimming sections than use of blankets
- fire resistant, moisture resistant

FOAMED IN PLACE — unreaformaldehyde

Where it's used to insulate:

finished frame walls
unfinished attic floor



- moisture resistant, fire resistant
- may have higher insulating value than blown-in materials
- more expensive than blown-in materials
- quality of application to date has been very inconsistent — choose a qualified contractor who will guarantee his work.

Blankets, batts, and pouring insulation can be bought from building supply dealers and home centers. Blowing insulation is supplied by the insulation contractor who installs it.

ENERGY CONSERVATION BULLETIN 1.2.1

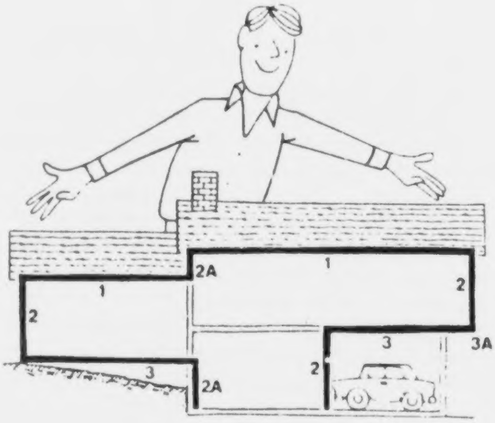
How To Insulate

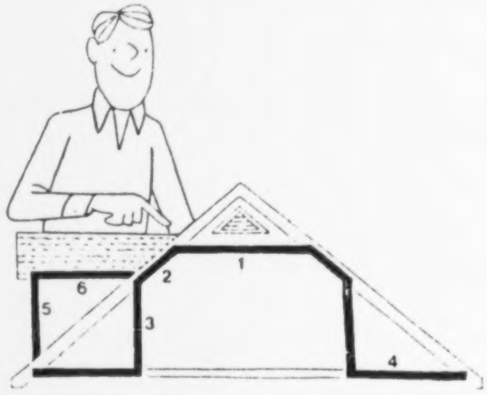
Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

Where To Insulate

The diagram shows where insulation goes. The numbers on it are keyed to the list below:

1. Ceilings with cold spaces above.
2. Exterior walls. The short walls of a split-level house (2A) should not be neglected. Walls between living space and unheated garages or storage rooms should be insulated, too. Walls that are enclosed on both sides can be insulated only by an insulation contractor.
3. Floors above cold spaces — vented crawl spaces, garages, open porches, and any portion of a floor in a room that is cantilevered beyond the wall below (3A).





Insulate attic living space as indicated in the diagram above:

1. Between "collar beams."
2. Between sloping rafters. Be sure to leave an air space for ventilation between the insulation and the roof deck (select insulation thickness accordingly).
3. Between the studs of "knee walls."
4. Between the joists of the floor outside the living space.
5. Dormer walls.
6. Dormer ceilings.

Tools To Do The Job Right

Sharp knife to cut blankets and batts. A serrated-edge kitchen knife works well.

Straight edge to cut along - a rigid metal rule or a short lenth of board.

Measuring tape if you don't use a metal rule as a straight edge.

Rake, or other tool, to push or pull blankets to the eaves edge if there isn't much headroom.

Walk boards — several pieces of ¾ inch utility-grade plywood, 12 to 16 inches wide and 4 feet long, or something similar. If you step on the top ceiling surface, your foot will plunge right through — so use walk boards.

Portable light, such as a mechanic's trouble light or a clamp-on photographic light. An extension cord, too.

Staple gun for applying wall insulation. It can be rented.

Precautions To Take

Treat electrical wiring with care. Don't try to pull it or bend it out of the way.

Even in the cleanest of homes, attics tend to be dusty. Wear old clothes.

Insulations fibers can cause temporary skin irritation, so wear work gloves and loose-fitting clothes, including a long-sleeved shirt.

Be wary of nails that stick through the roof sheathing above your head.

Don't smoke in the attic.

Provide good lighting

Don't place insulation near electrical light fixtures, a furnace, or similar heat-producing device. Extreme heat, even without a flame, can ignite some insulation.

ENERGY CONSERVATION BULLETIN 1.2A.1

How To Insulate (Attic)

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

Three different types of insulation are appropriate for attic work:

BATT TYPE: slabs of lightweight glass or mineral fibre. Available with or without a vapor barrier on one side

BLANKET TYPE: identical to batt type, except sold in continuous rolls.

LOOSE FILL: a variety of loose materials made up of small particles ranging in texture from granular to fluffy.

—BATT/BLANKET TYPES:

- in most circumstances these types are more easily handled and applied than loose fill.
- they are pre-manufactured, with the quality assured.
- they are the most suitable insulation materials for vertical surfaces in the attic (though rigid insulation could also be used)
  they can be installed with an attached vapor barrier if desired
- the cost per unit of R-value is generally higher than for loose fill.
- the choice between batt and blanket types will depend upon the particular job to be done. Blanket insulation is often more awkward to install.

—LOOSE FILL TYPES:

- best suited for non-standard or irregular joist spacing or when space between joists has many obstructions. Gets into small areas.
- loose fill generally costs less per unit of R-value than batts or blankets.
- if a vapor barrier is desired, it must be applied separately from the insulation.

—IF USING BATT/BLANKET TYPE:

- the differences between glass and mineral fiber are are not large. Glass fiber is easier to handle and may fill the space more effectively than some mineral fiber batts. On the other hand, mineral fiber tends to have a higher R-value per inch. Make your choice accordingly.

—IF USING LOOSE FILL TYPE:

- glass and mineral fiber are fire and moisture resistant.
- cellulose fiber has a higher insulation value for a given thickness. It is made from recycled newsprint, and as such reduces waste in other areas. It is less prone to undesirable settling than other loose fill insulations. It is treated with a fire retardant, though some formulations may not last the lifetime of the insulation. The insulation does absorb water, and therefore should not be used where water can come in direct contact with the insulation.
- loose polystyrene has the best moisture resistance of the loose fills, but can increase the fire hazard. The shredded variety will be substantially less expensive than the beads.
- Vermiculite is quite expensive per unit of R-value, relative to other types. Even the water resistant variety will absorb moisture and possibly cause problems. It does have a very high fire resistance.
- Wood shavings are suitable for ceiling use only. If locally produced and treated to give fire resistance, shavings may represent good value. The same moisture considerations apply as with cellulose fibre.
- Wood wool may be used if available locally at competitive prices. Purchase it only if it has been treated with fire retardant. If moisture is likely to be a problem, use a moisture resistant insulation.
- If you are using loose fill insulation and plan to pour it into place, make sure you purchase the "pouring" type. The "blowing" type must be blown in by a special machine, unless stated differently by the manufacturer.

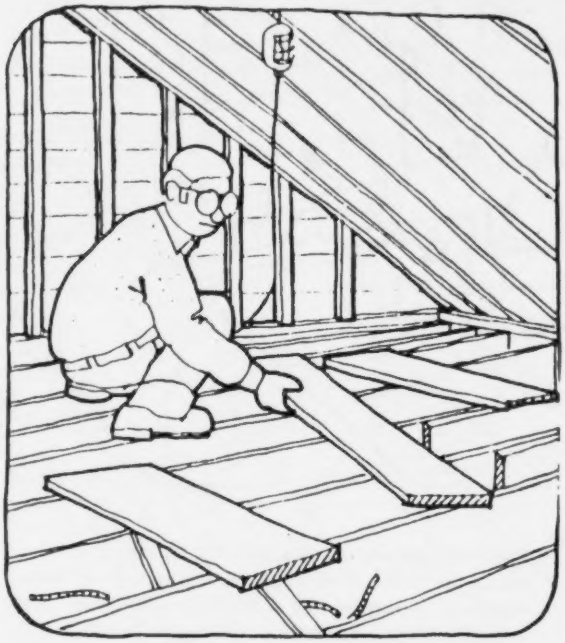
Choose the insulating material best for your job. If 2 or more materials seem appropriate, decide on the basis of price! Finally, decide what R-value you are going to install (if you haven't already).

Installing Attic Insulation

If your attic is large enough to work in, but there is no access hole, you should probably cut one. This will allow you to do a good job at a reasonable cost. Cut the hole in an out of the way place (such as a cupboard), making sure that no structural supports are damaged.

Tools Required

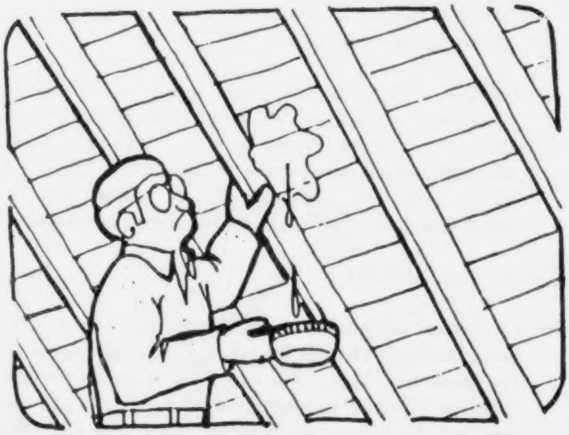
—temporary lighting
—temporary flooring
—if you are installing a vapour barrier,
—a roll of good quality tape, compatible with the barrier you are using
—heavy duty staple gun (you should be able to rent this) and staples; alternatively a hammer and tacks
— heavy duty shears or linoleum knife
— rake or some tool to manoeuvre insulation into place around eaves when there isn't enough headroom.



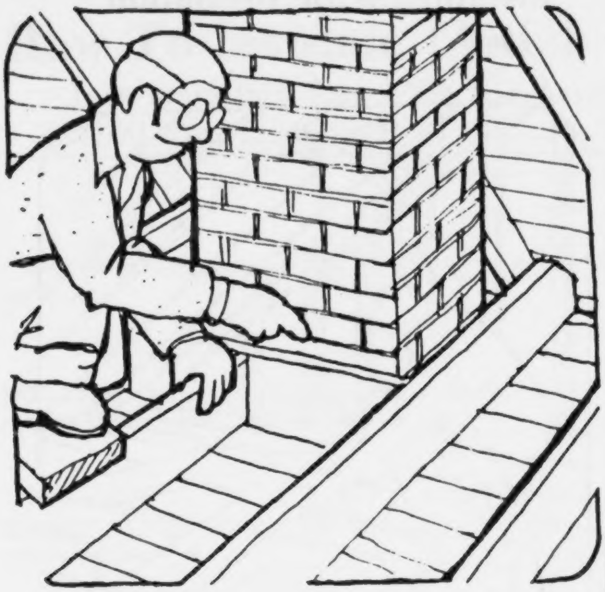
1) Install temporary lighting and flooring. Keep insulation wrapped until you are ready to install it. If possible, unwrap batts and blankets in the attic, since they expand and become less manageable after opening.

Safety

1) Provide good lighting
2) Lay boards down over the tops of the joists or trusses to form a walkway (the ceiling below won't support your weight).
3) If roofing nails protrude through the roof above, be careful! You may want to wear a hard hat.
4) If you use glass or mineral fibre, wear gloves and a breathing mask, and keep the material wrapped until your are ready to put it in place.
5) Locate all electrical wiring in your attic, and then avoid all unnecessary contact with it.



2) Check for leaks in the roof — wetness or water stains. If there are any, repair them first.



3) Check also for any obvious air leaks into the attic from inside the house. Seal all places where pipes or wires (careful!) penetrate the attic floor. Similarly, seal around ceiling light fixtures, the tops of inside walls, chimneys, hatches, and so on. Caulking, oakum, and polyethylene scraps are recommended, though polyethylene should be kept away from any direct source of heat such as a light fixture. It is especially important to ensure that no exhaust fans discharge into the attic. If they discharge to the outside, make sure the exhaust vent is not directly below the eave vents.

4) If you have done your best to cut down air leakage into the attic, and moisture problems persist, you may have to install additional ventilation. In most cases, this should not be necessary.

5) EXISTING INSULATION: make sure it is dry and in reasonable condition. Many old houses will have unusual insulation types, such as seaweed, wood shavings, or old newspapers. Whatever the kind, if it is wet, remove it altogether. Before adding new insulation, locate and eliminate the source of moisture.

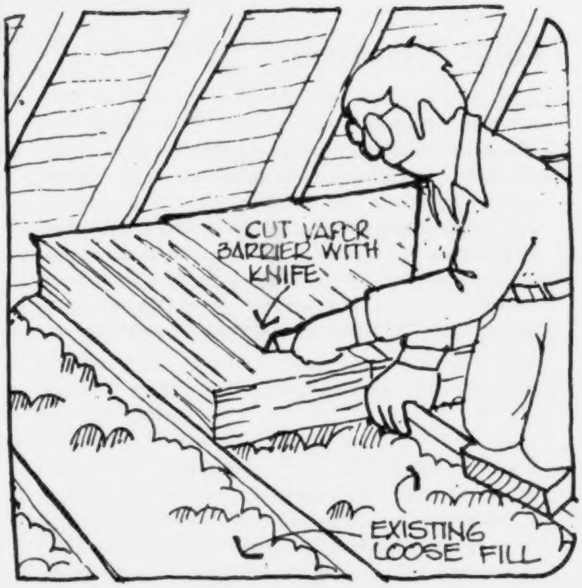
6) VAPOR BARRIER

— If there is an existing vapor barrier, your job will be easy. Patch any obvious breaks in it, then proceed with the insulation. If you are using batts, try to get the "friction fit" type with no attached barrier. If you can only get the built-in vapor barrier type, then place the barrier on the upper side and slash it with a knife to allow air to pass.

— If there is no existing vapor barrier and no existing insulation, install a barrier as outlined below.

— In a case where there is no existing vapor barrier, but insulation is present, a barrier should never be placed on top of the existing insulation. Under some circumstances, it may be necessary to lift the insulation and put a barrier under it. However, if you have been having no moisture problems to date, if you are conscientious in sealing air leaks through the ceiling, and if humidity levels in the house are reasonable — then no problems should result from adding more insulation without any vapor barrier. Additional moisture protection can be achieved by painting the lower side of the ceiling with two coats of oil-based paint or a single coat of spar varnish.

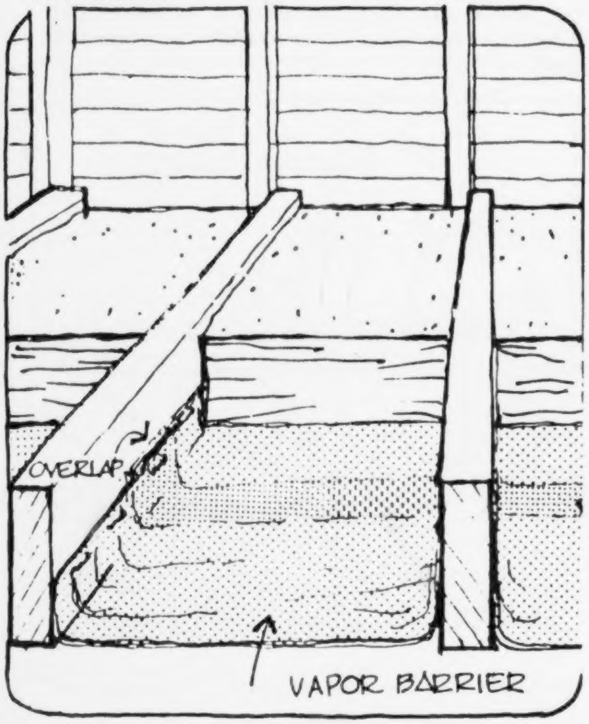
If you do not add a barrier, it is probably worthwhile to check the attic after a cold snap in January or Febraury. Some frost buildup is to be expected, but if it is particularly heavy, you should work harder at sealing air leaks into the attic!


CUT VAPOR BARRIER WITH KNIFE
EXISTING LOOSE FILL

7) INSTALLATION OF VAPOUR BARRIER (if required)

— The polyethylene should be cut into long strips about 4 inches wider than the joist spaces.

— Being careful to get right to the edges, the sheet should be laid down as shown. It should be stapled to the extent necessary to keep it from moving during installation of the insulation.



NOTE: The polyethylene should not be slung over the joists, as this could trap moisture between the plastic and the wood - an undesirable situation!

— Seams should be overlapped about 6" and, for optimal coverage, taped as well.

— Any obstruction in the attic, such as wooden braces or electrical wires (careful!) will require cuts in the barrier. Seal these as much as possible with tape and small pieces of polyethylene.

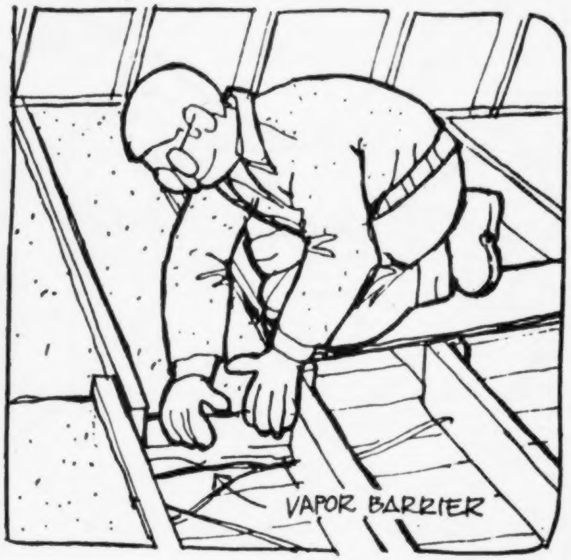
8) INSTALLATION OF THE INSULATION

Depending upon the type of insulation you are using, you should follow the directions given in EITHER A OR B.

A: BLANKET OR BATT INSTALLATION

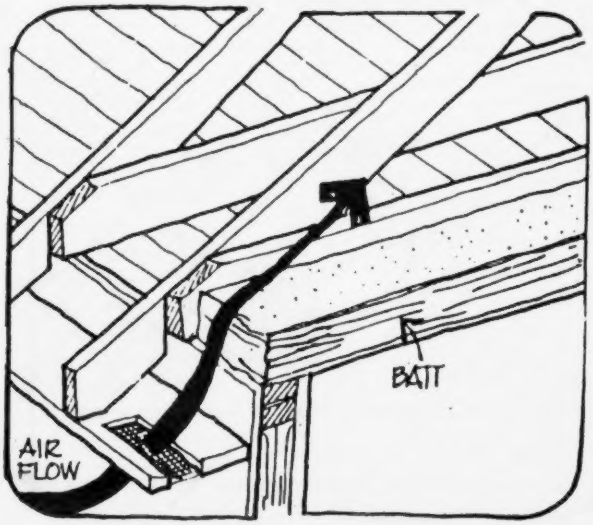
— blanket type insulation is applied in basically the same way as the batt type to be described below. It may be precut with scissors, or cut on the spot. Start at one end of the attic, and unroll!

— batt type insulation is simply pressed into place between the floor joists. If you purchased the correct width, it will fit snugly. No stapling in place is necessary.

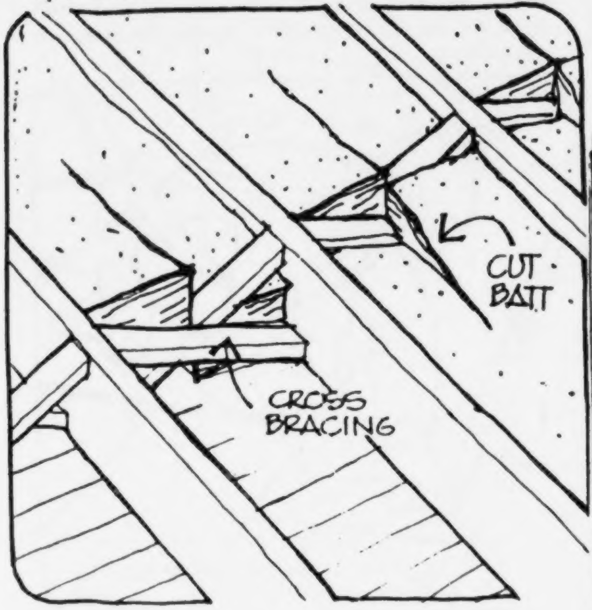


— if using a bat with attached vapor barrier, the barrier should be on the side towards the living area. Any tears in the barrier should be sealed with tape. Do not put this kind of insulation on top of existing insulation.

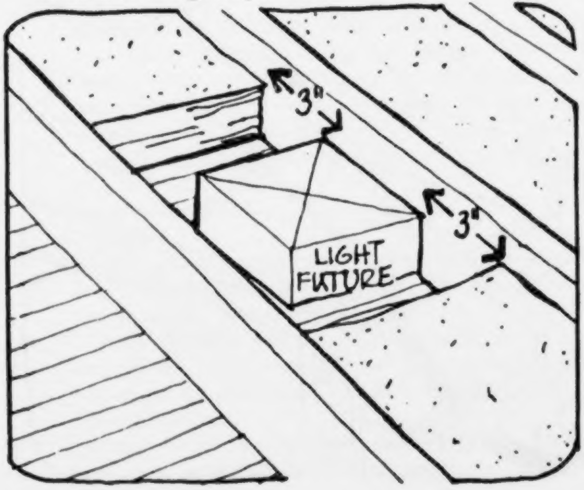
— batts should not block the venting, but otherwise should extend as far as possible towards the eave.



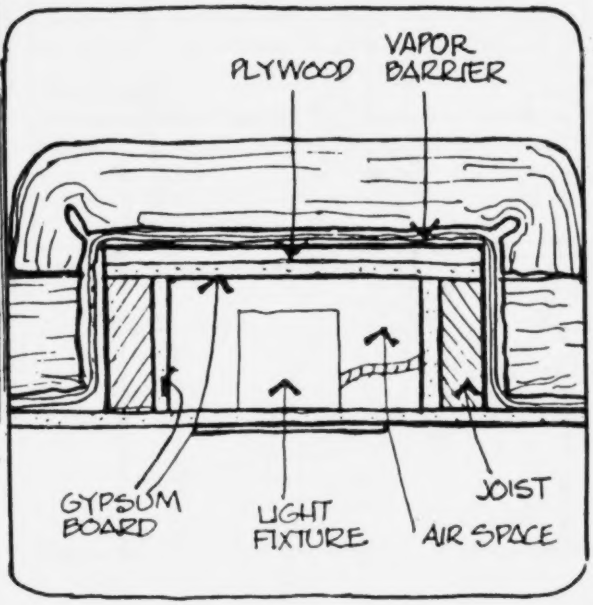
- butt the ends of different batts together as tightly as possible.
- insulate tightly around cross bracing using diagonal cutting as illustrated. If possible, avoid cutting the vapor barrier.



- do not insulate any closer than 3" from any recessed light fixtures or other heat sources such as an exhaust fan motor. Heat build up could lead to a fire hazard. On the other hand, the fixture will continue to be a major heat loss and possibly a moisture problem. The best solution is to eliminate the fixture if at all possible. If not, at least caulk any obvious openings with a heat resistant caulking compound.



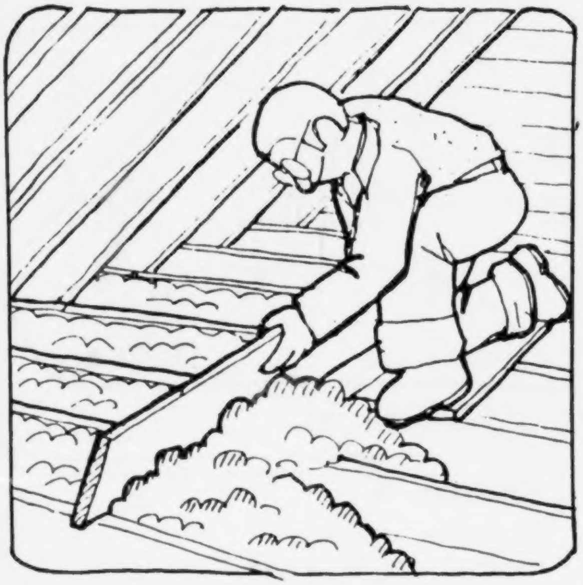
If the fixture does not touch any of the joists, and if any heat build-up could escape readily into the room below, you might consider building a box of plywood around the fixture. Line the inside of the box on all surfaces with gypsum board, leaving an air space all around the fixture. The box should then be insulated normally. **Only undertake such a project if you are certain no problems will arise.**

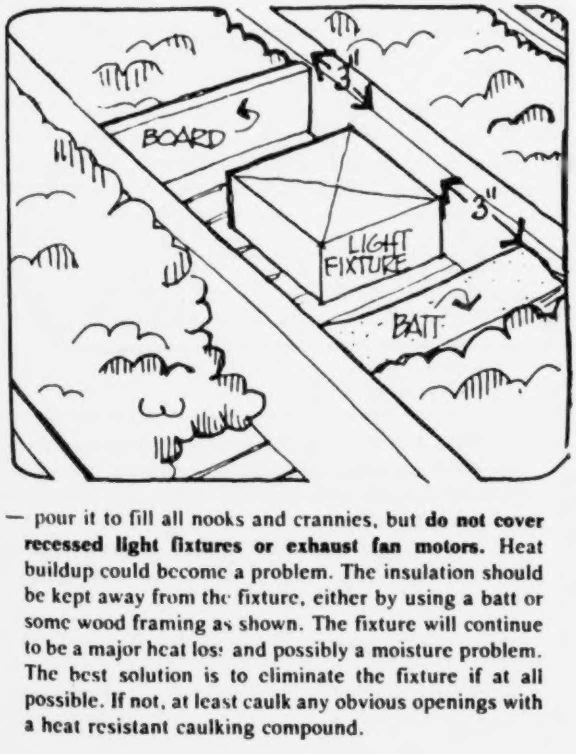


- insulate around the chimney with non-combustible materials. Unfaced glass or mineral fibre is fine.
- if you are installing more than a single layer of insulation and the first fills the joist space entirely, lay the second at right angles to the first. The second of course, should not have a vapor barrier.
- finally, don't forget to insulate and weatherstrip the hatch into your attic!

B: LOOSE FILL INSULATION

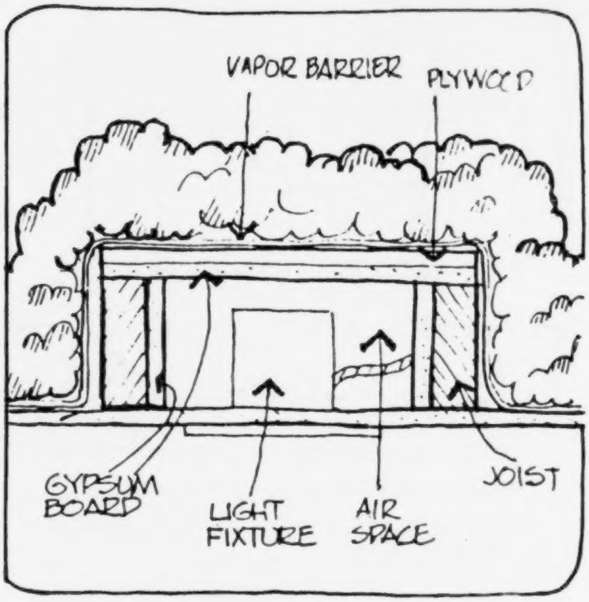
— loose fill insulation is simply poured in on top of the vapor barrier. It is levelled off with a board or garden rake, as illustrated. If you are adding insulation to a depth greater than the height of the joists, the extra thickness makes levelling a bit difficult — but it will be worth it.

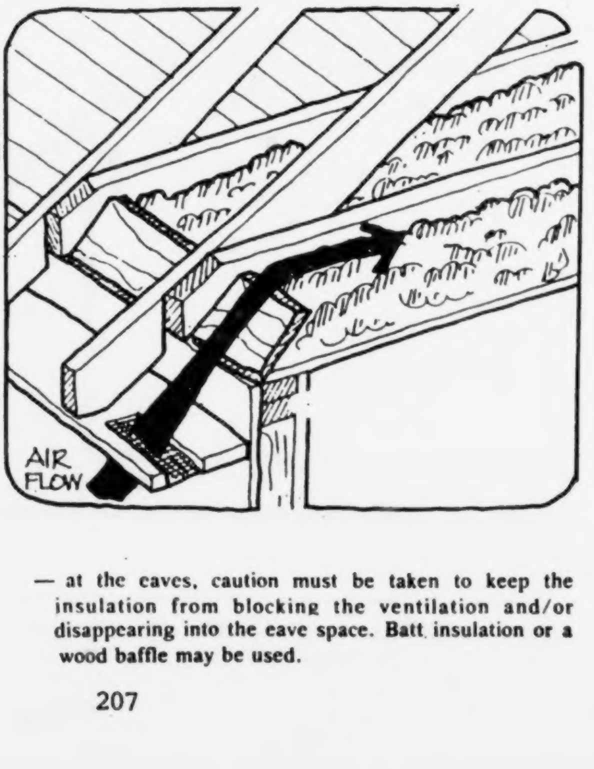




— pour it to fill all nooks and crannies, but **do not cover recessed light fixtures or exhaust fan motors.** Heat buildup could become a problem. The insulation should be kept away from the fixture, either by using a batt or some wood framing as shown. The fixture will continue to be a major heat loss and possibly a moisture problem. The best solution is to eliminate the fixture if at all possible. If not, at least caulk any obvious openings with a heat resistant caulking compound.

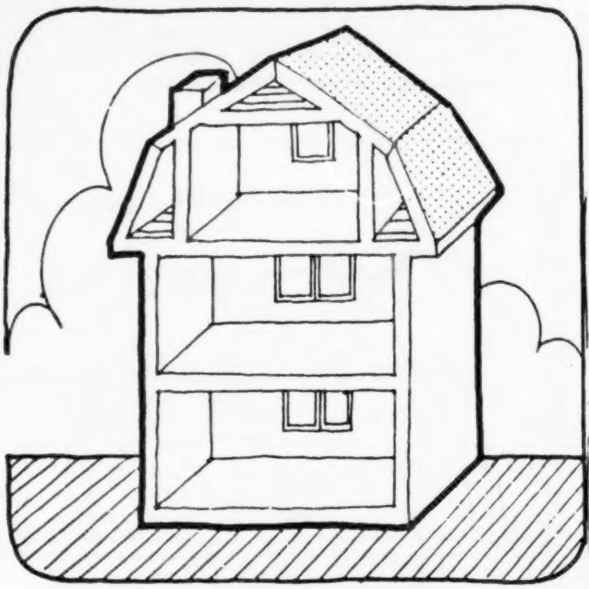
If the fixture does not touch any of the joists, and if any heat build-up could escape readily into the room below, you might consider building a box of plywood around the fixture. Line the inside of the box on all surfaces with gypsum board, leaving an air space all around the fixture. The box should then be insulated normally. **Only undertake such a project if you are certain no promblems will arise.**





— at the eaves, caution must be taken to keep the insulation from blocking the ventilation and/or disappearing into the eave space. Batt insulation or a wood baffle may be used.

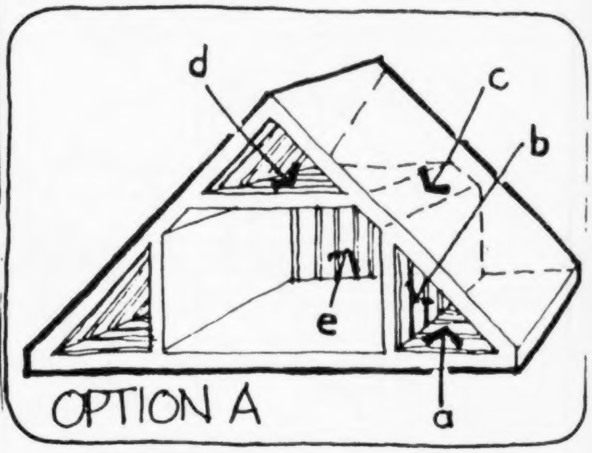
Complications: The 1 1/2 And 2 Story House



These buildings can be difficult! Insulation should be applied in either of two ways in order to create a complete heat-retaining envelope:

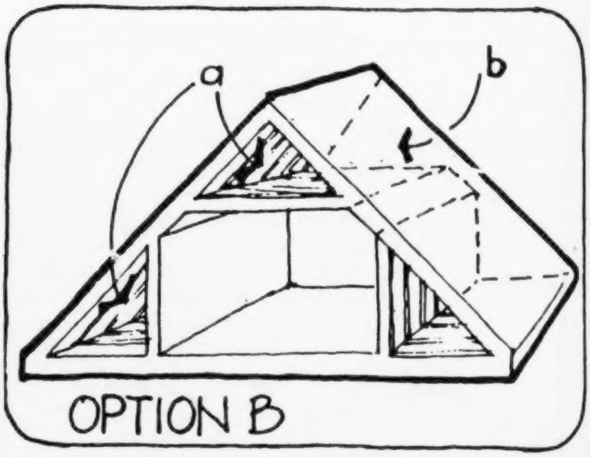
Option A

a) outer attic floor
b) the so-called "knee-wall"
c) short section of rafters
d) attic ceiling
e) end walls of attic room



Option B

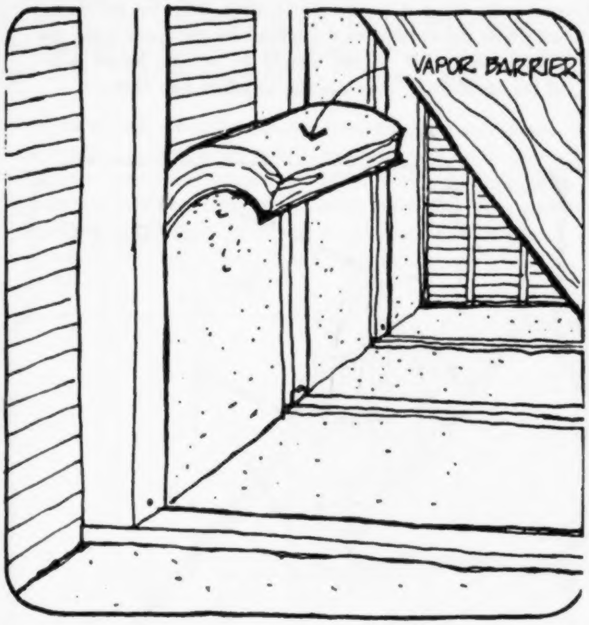
a) full length or rafters
b) complete end walls of house



Method A is the preferred insulation program, since it cuts down on potential moisture problems, produces a more comfortable room (warmer walls), and reduces the total space to be heated.

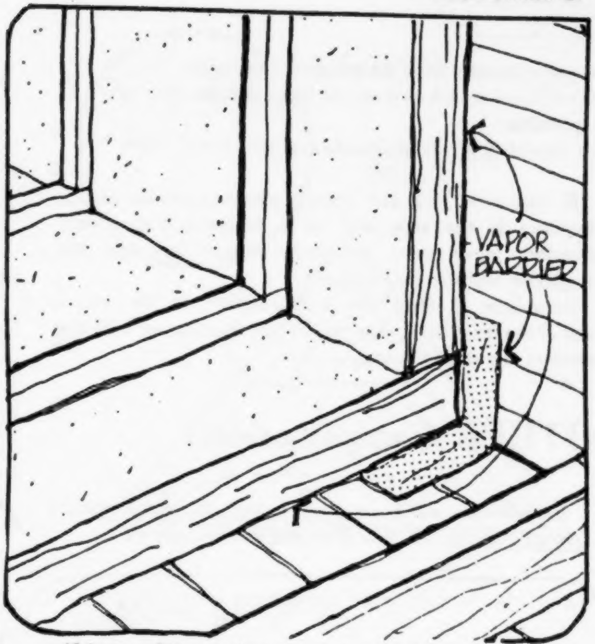
If you can get into these spaces to work, you can do-it-yourself. Otherwise, a contractor will likely be necessary.

1) Treat the outer attic floor and the attic ceiling (designated (a) and (d) in figure A above) exactly as described for standard, unfinished attics on the previous pages.

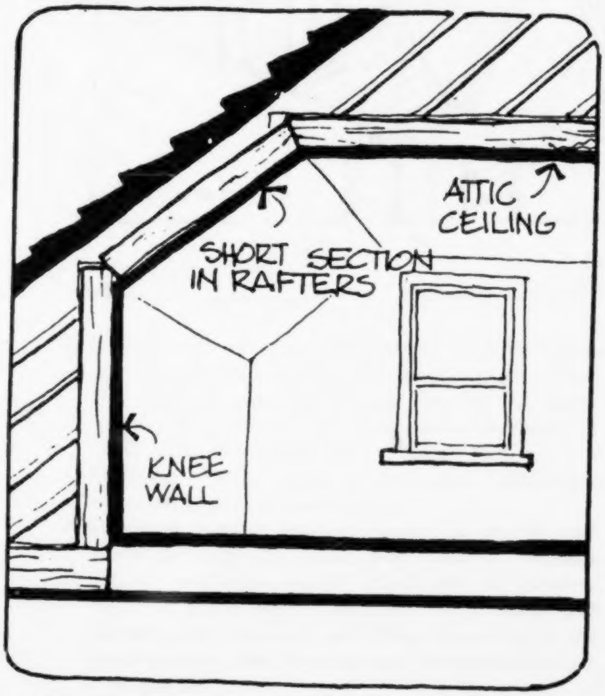


The knee wall (designated (b) in figure A) should be treated in much the same way as the unfinished attic floor described on the previous pages, making appropriate allowances for the fact that it stands upright:

- batt insulation should be used in preperence to loose fill (for obvious reasons).
- rigid foam insulation could theoretically be used. However, in confined attic spaces, batts are likely to be much more easily handled (and less expensive!).
- before beginning, any obvious air leaks should be caulked.
- the vapor barrier should be applied on the warm side of the insulation.



- if batts with attached vapor barriers are being used, then special care should be taken at the joint with the outer attic floor and at the joint with the attic ceiling. An additional strip of polyethylene should be applied to seal the joint, as illustrated.
- if there are any electrical outlets (carefull!) or pipes in the knee wall, then make sure you keep them on the warm side of the vapor barrier and insulation.



The section in the rafters (designated (c) in figure A above) may be filled right up with insulation if:

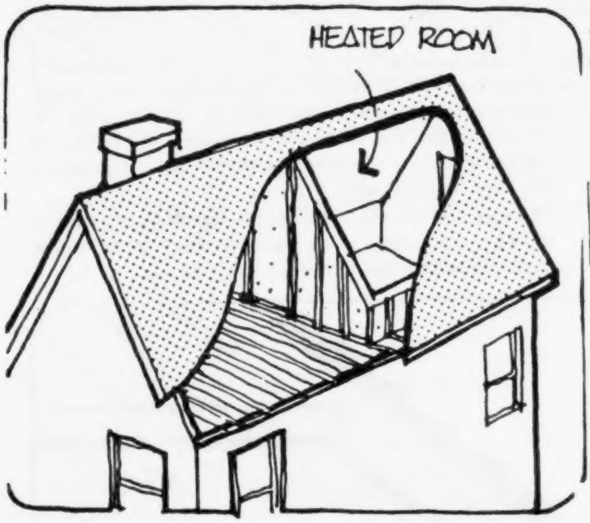
- you currently have no moisture problems,
- you have sealed as many air leaks into the attic space as possible,
- humidity levels in your house are not excessive

If, however, you are unsure about whether or not moisture in the attic will be a problem, you should probably leave some ventilation space between the insulation and the roof above it.

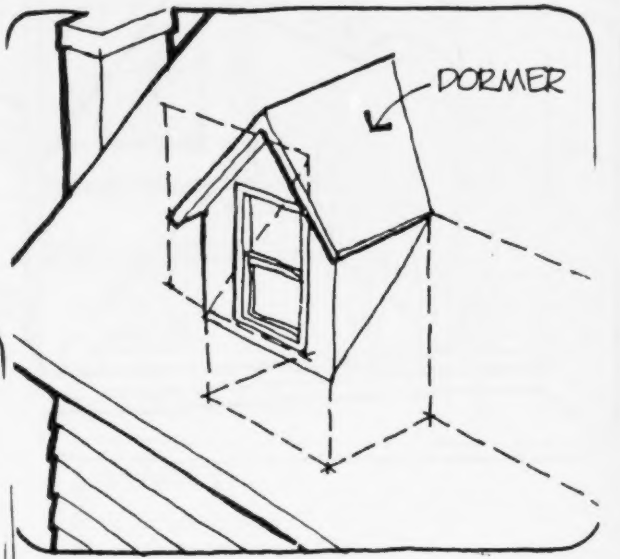
Remember to place the vapor barrier on the inward side of the insulation, making it nearly continuous with the barriers above and below.

OTHER Complications

Some houses will have a wall in the attic that adjoins a heated space. Insulate it as you would knee wall



- Many houses with accessible attics also have dormer windows.
- the walls shaded in the illustration may be insulated with batt insulation, as described for the knee wall. As always, the vapor barrier should be on the heated side of the insulation, overlapping at joints and corners.



- the remaining walls and the dormer ceiling are much more difficult. A contractor may be able to re-insulate it for you. If you're having a contractor do work on the walls anyway, it may be worth your while to have the dormers done at the same time.

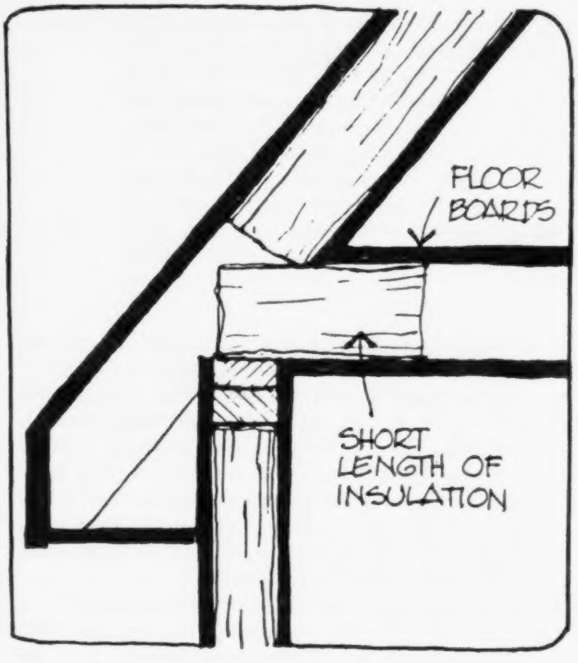
- Some houses will have the attic floored over, even though it's not used as living space.
- you can re-insulate it yourself by lifting the floor boards and treating it as you would an unfinished attic.
- you can have a contractor blow loose insulation through a few small holes into the sub-floor space, completely filling it up. Choose the contractor with care. Before he begins, calculate the R-value that you expect to achieve, given the space between the attic floor and the ceiling below. Then, check the bags of insulation to be used. They should indicate what area one bag will cover at the selected R-value. You and the contractor should then agree on the total number of bags to be used. There is no way of installing a vapor barrier in this case. If one does not exist, it should be acceptable to install the insulation if the following conditions are met (even if there is a vapor barrier, these conditions are worthwhile!):

1) there is no evidence of existing moisture problems
2) humidity sources in the house are reasonable

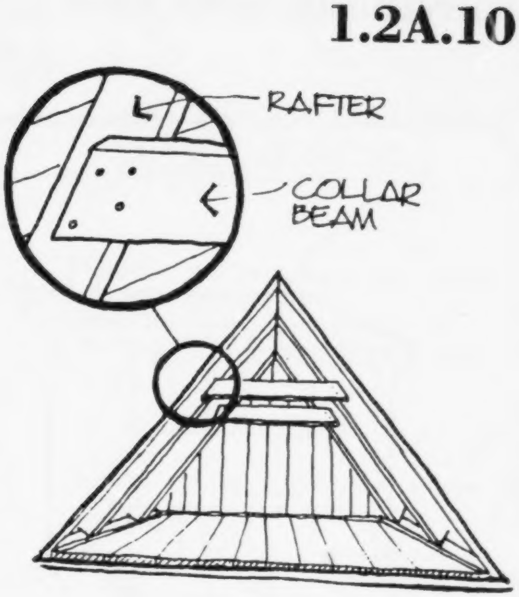
3) the floor above the insulation will allow air to pass
4) an effort has been made to plug all air leaks into the attic from the house below
5) the attic is adequately ventilated

When there is no vapor barrier, added protection can be achieved by painting the underside of the ceiling with a coat of spar varnish or two coats of oil based paint.

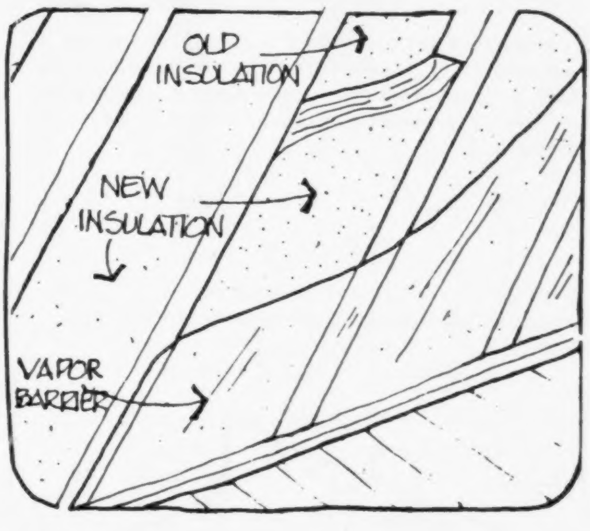
— If you expect to finish your attic some day, you may want to insulate between the rafters instead. Just remember that the process is somewhat difficult and may create moisture problems. Furthermore, until you actually start using the attic, you'll be heating a lot of unused space. If you choose to do it, the steps to take are briefly as follows:



1) The wall space immediately below the attic floor must first be insulated. This will be easy if the floor boards can be lifted. Simply pack the space with batt type insulation as shown.



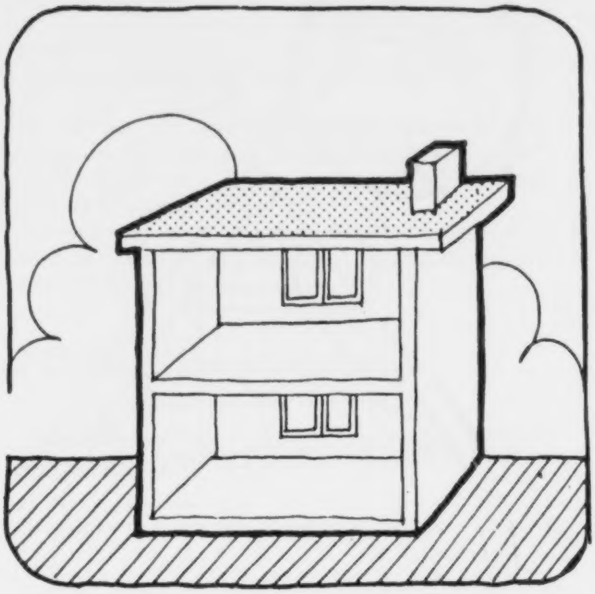
2) Install collar beams between every pair of rafters, as illustrated.



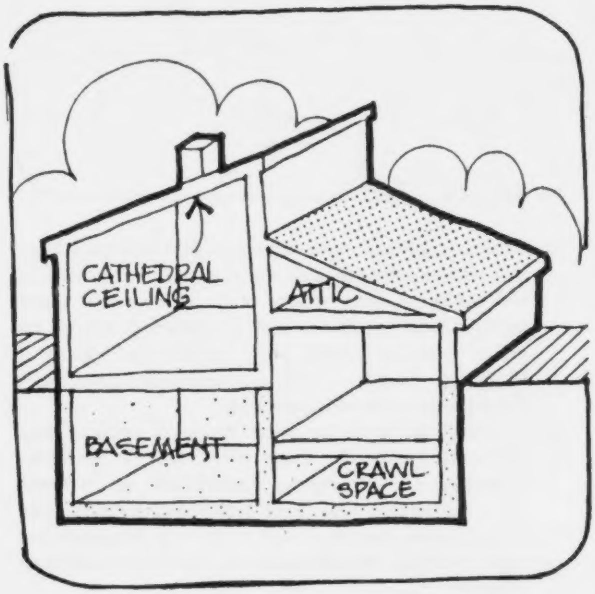
3) If there is already some insulation between the rafters and between the end wall studs, move it to the back of the rafter or stud space, and destroy the vapor barrier. Next, apply the new insulation (it should be either glass or mineral fiber "friction fit" batts) as illustrated. Finally, staple a continuous polyethylene vapor barrier to the rafters and studs.
4) Insulation between the collar beams is applied from below in much the same way, with a continous polyethylene vapor barrier applied last. If, however, the collar beams were there before this operation and already been insulated, and if there is access to the upper portion, then the space may be re-insulated like a normal attic.
5) Finally, block off and seal any ventilation into your attic, which is not heated!

There Really Is No Attic

1.2A.11



A house (or any portion of a house) with a flat roof, a cathedral ceiling, or some other "atticless" construction is likely to be a difficult case, almost certainly requiring the services of a qualified contractor. Three options are available:



a) If the roof has exposed joists or beams (usually left exposed for decorative purposes) it may be possible to close the space in, creating a new ceiling. Framing may need to be added; then insulation batts; next an extremely effective vapor barrier, blocking virtually all air flow; and finally the new ceiling. If there is an existing vapor barrier, it may cause problems unless it is destroyed or the new barrier below is much more effective than the original. In all cases, moisture could cause difficulties in such a project.

b) The existing space between the ceiling and roof can be blown full of loose fill insulation by a contractor. Since this eliminates any ventilation altogether, it is not generally a recommended practice for existing homes. If you do choose this insulation program, make sure air leaks into the ceiling are sealed and the vapor barrier is intact. Have the contractor blow in cellulose fiber (because of its high density) at a density of 3-4 lbs. per cubic foot.

c) Insulation may be added on top of the existing roof. This option is likely best, and is particularly attractive if the existing roofing needs replacing. It should, nevertheless, be undertaken by a qualified roofing tradesman.

The job can be done in a number of different ways, using a number of different materials. However, the most suitable insulation material is generally extruded polystyrene. Consult with your roofing contractor regarding the best approach for your house.

ENERGY CONSERVATION BULLETIN 1.2B.1
How to Insulate (Walls)

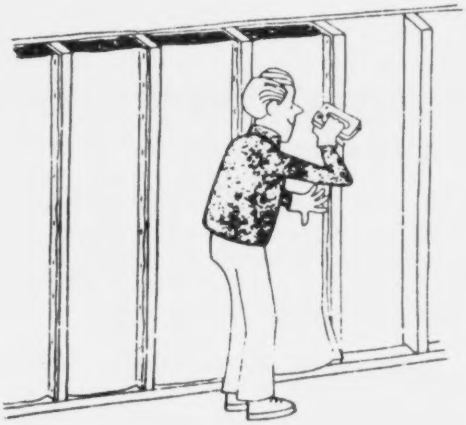
Intermountain Rural Electric Association 303 794 1535
2100 West Littleton blvd Littleton Colo 80160

Option A: Wall Batts

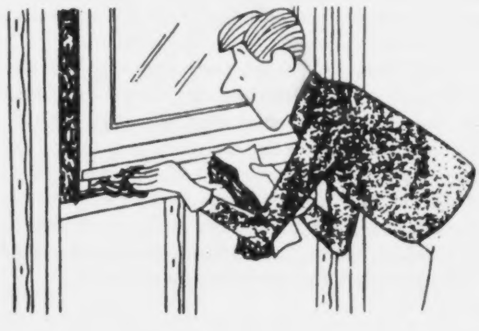
FIGURING HOW MUCH INSULATION YOU'LL NEED

First, calculate the overall area to be covered — multiply the length by the width. Then adjust this number to allow for the area taken up by joists or studs. If joists or studs are 16 inches apart, multiply by .90. If they are 24 inches apart, multiply by .94. The anwer is the number of square feet of insulation you'll need.

To insulate a wall, fit the end of a blanket snugly against the top piece of framing. Working down, staple the flanges to the sides or the faces of the studs. (With aluminum foil-faced blankets, staple to the sides to create an air space, which is necessary for the heat-reflective value of the foil to be achieved.) Space the staples about 8 inches apart. Cut the blanket to fit tightly against the framing at the bottom. If more than one piece of blanket is used in the same stud space, butt the ends tightly together. The vapor barrier must face the side of the wall that is heated in winter.

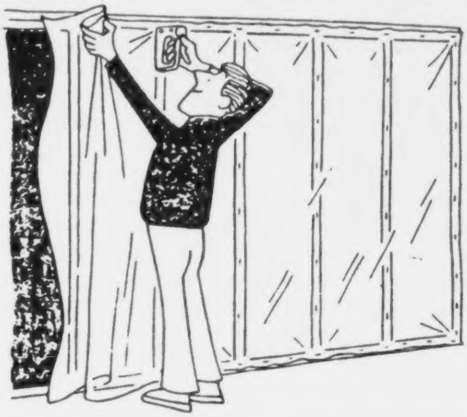


Cracks and very narrow spaces, such as those around window frames, should be stuffed by hand with loose insulation and covered with a vapor barrier.



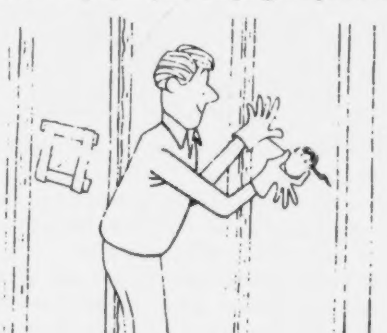
To insulate stud spaces that are narrower than normal, cut the insulation about 1 inch wider than the space to be filled. Staple the remaining flange, then pull the vapor barrier on the other side to its stud and staple through the barrier.

Walls can be insulated with unfaced blankets and a separate vapor barrier, either 2-mil-or-thicker polyethylene sheeting or foil-backed gypsum board. Keep polyethylene taut as you apply it. Staple it in place.



Install insulation behind pipes and ducts (to keep them warm) and behind electrical boxes. Spaces of this sort also may be hand-packed with loose insulation. To get loose wool, pull pieces from a blanket.

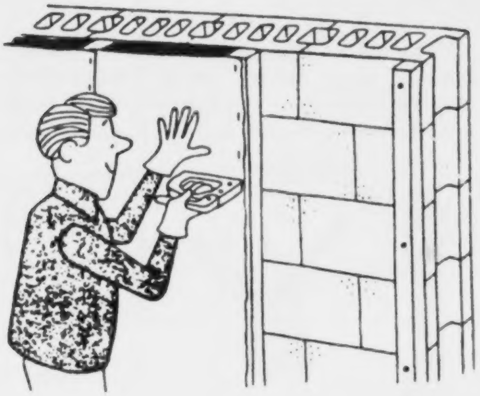
DO patch the vapor barrier of wall insulation if it has been torn. Strip a piece of vapor barrier from a scrap section of blanket or use polyethylene, taping the patch to secure it.

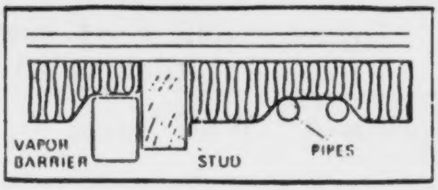


DON'T allow gaps, or "fishmouths," at vapor barrier edges when you are insulating walls. Keep the edges tight against the studs.

Masonry walls, basement walls and the like, are insulated by first fastening 1x2, 2x2, or 2x4 furring strips in place vertically. They should be placed 16 or 24 inches from the center of one strip to the center of the next.

With 1x2 furring, use special "masonry wall" blanket insulation (an unfaced material, of about an R-3 rating, which should be covered with polyethylene for foil-backed gypsum board to provide a vapor barrier). With 2x2s or 2x4s, install R-7 or R-11 blanket insulation as in any other wall.





IF OBSTRUCTIONS - ducts, pipes, and the like - are located in the wall cavities, push insulation behind (to the cold side in winter) those pipes before stapling. Or you can pack the space with loose insulation or cut a piece of blanket insulation to fit the space. If you do pack the space with loose insulation, make certain you cover it with 2-mil-polyethylene

NOTE: If there is evidence of existing moisture problems in your wall, make sure that you deal with them first, before adding insulation. Check for leaks where water might enter from the outside or where air might enter from the inside.

Option B: Loose Polystyrene

If your house has a wall space which opens into the attic and if the space is continuous right down to the foundation (check it with a weight on a string), then you can simply pour loose polystyrene (the shredded variety will be cheaper than the beads) into the wall cavity. Make sure you fill each stud space right to the top.

— Some of the spaces are certain to be interrupted by windows or some other obstruction. In such a case, it will be necessary to have the lower portions blown full by a contractor. The cost of this will be minimal when compared to the cost of doing an entire house by this method.

— Since it is not possible, by this method, to install a vapor barrier, you should endeavour to seal all air leaks from the inside of the house into the wall space.

You should also be careful not to develop excessive humidity in the house. Finally, further protection can be achieved by painting the inside of the wall with spar varnish, or two coats of oil-based paint.

— Any partial obstructions in the wall space (wires, pipes, etc.) can prevent the insulation from completely filling the cavity. Any "jam-ups" around these barriers can generally be loosened by beating on the inside wall at the appropriate point! In many cases, it is recommended that you go up into the attic a couple of times over the next few months, to check for settling. If there is any, re-fill the spaces to the top again.

Option C: Foamed In Place Insulation

The cavity in wood frame houses and in some masonry walls (i.e. stone, brick etc.), can be filled with foamed-in-place insulation. The material is injected into the cavity as a semi-liquid foam, which quickly solidifies to give a solid insulation material.

The polyurethane foams now available on the market are not recommended for this application as they expand greatly in the wall cavity, causing possible bursting or warping of the walls.

Urea formaldehyde foam may be acceptable, however, a number of formulations are subject to shrinkage, degradation and moisture problems. You should consider this approach only if the contractor is prepared to guarantee his work in writing, accepting liability for any damage done to the house by the insulation.

Application procedures and comments are similar to those offered below for blowing in loose fill insulation. However, special attention must be paid to moisture, since the foam contains 1½ to 3 lbs. of water per cubic foot. As it dries out, the moisture must escape from the wall — otherwise it can cause serious problems. The situation is much less serious in masonry walls, since they are less affected by water. Nevertheless, precautions need to be taken to ensure that problems do not arise.

Option C: Blown In Insulation

If you have hollow or almost hollow wood frame walls then you can have a professional insulation contractor blow in loose fill insulation. This is the most common means of reinsulating an exisiting wall. Before you proceed, however, remember that the stud space is likely only about 3½ inches thick. If there is already a couple of inches of insulation, the benefits of blowing in more will be small. It might be preferable to invest the time and money on other parts of the house.

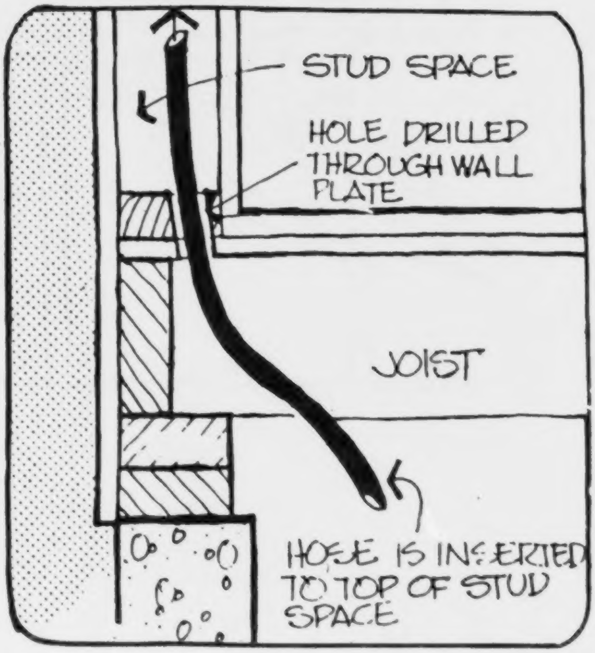
If you decide to proceed, choose the contractor carefully. You won't get a worthwhile return if the contractor cuts corners.

An access hole must be drilled into each stud space in the walls; in some cases two are needed. There are four possible ways of doing this:

1) FROM THE INSIDE WALL: This is to be discouraged in cases where there is an existing vapor barrier, as the drilling will destroy that barrier.

2) FROM THE OUTSIDE WALL: Most types of exterior siding can be drilled and then patched with little or no evidence of the work. Brick sliding can have single bricks temporarily removed. Make sure the installer patches the individual holes as he moves, rather than leaving them all until the end. Otherwise you may end up with several rain holes in your wall when that flash storm hits!

3) FROM THE BASEMENT: This can be the easiest approach. A long tube is inserted to the top of the stud space, and then withdrawn as the space fills. The pressure packs the material from the top down.


STUD SPACE
HOLE DRILLED THROUGH WALL PLATE
JOIST
HOSE IS INSERTED TO TOP OF STUD SPACE

4) FROM THE ATTIC: In a similar manner, a hole can be drilled in the top place of the wall. A hose is then inserted from the attic, down the wall. As the space fills, it is withdrawn.

All spaces in the wall need to be filled — fire breaks, cross braces, and other obstructions in the wall cavity need to be allowed for. It is worthy to note that cellulose fiber in a blow-in application will more readily fill irregular spaces than the other materials. Carefully choose the insulation to be used in consultation with the contractor.

When you have settled on the material, figure out how much should be used. The bags of insulation will indicate on them how many square feet each should fill to give the required R-value. Make sure the information used is for wall applications. Knowing the size of the wall to be filled, you and the contractor should agree on the number of bags to be used — and write it into the contract. Only a small variation from the target is acceptable. If he uses too little, you will find that the insulation settles, leaving gaps in the wall. If he uses too much, some of the insulation may be escaping from the wall into a floor space or some other area where it is not needed — a big waste! So make sure the right amount is used.

If there is no vapor barrier, it may still be possible to proceed, since the insulation itself helps restrict air flow. Cellulose fiber blown in at high density is particularly effective in this regard. At the same time, an active program to seal all air leaks into the wall and cut down on humidity sources should be undertaken.

DO paint interior walls as a substitute vapor barrier if you are having a contractor install blowing insulation. Use two coats of vapor-resistant paint and brush them in well. (Paints vary widely in the rate at which they allow water vapor to pass through. Ask a paint dealer about the "perm rating" — vapor permeability rating — of the paint he carried. A rating of 1 perm or less for primer and finish coat combined is considered good. If the dealer doesn't know about perm ratings, ask him to check with the manufacturer.)

Compare your needs with the various available options, and choose the one that seems most suitable. In a majority of cases, that will be blowing in insulation. The investment will be fairly high, but remember that it will be recovered in time. After that, it is money in the bank for you — and you have a better house for it!

Option D: Wall Renovation

If your plans permit extensive renovation, you have two options:

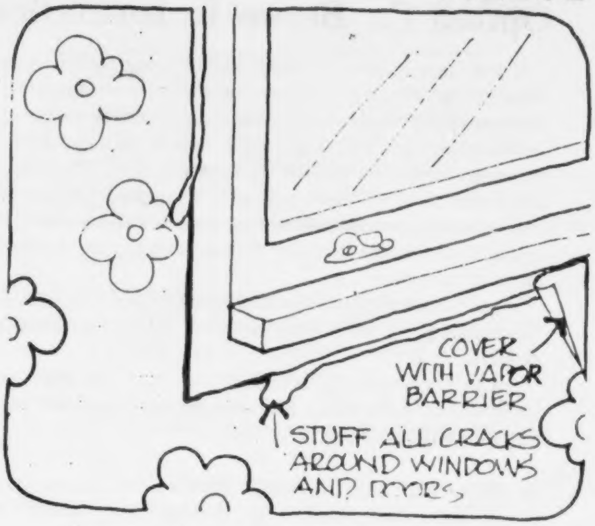
1) REBUILD THE EXISITING WALL: With wood frame house only, you may remove the wall board or plaster already in place and re-insulate the wall. While you are at it, you may want to attach 1x2" or 2x2" strips to the stud edges to allow for more insulation in the wall cavity.

2) BUILD A NEW WALL INSIDE THE OLD: With both wood frame and masonry walls, you may build a new wall inside the existing one, and then insulate it. This approach is only possible if there is no vapor barrier in the exisiting wall, or, if there is, its effectiveness can be reduced (by cutting for instance).

— Rigid foam, fiberglass or mineral fiber batt insulation may be used for this type of application.

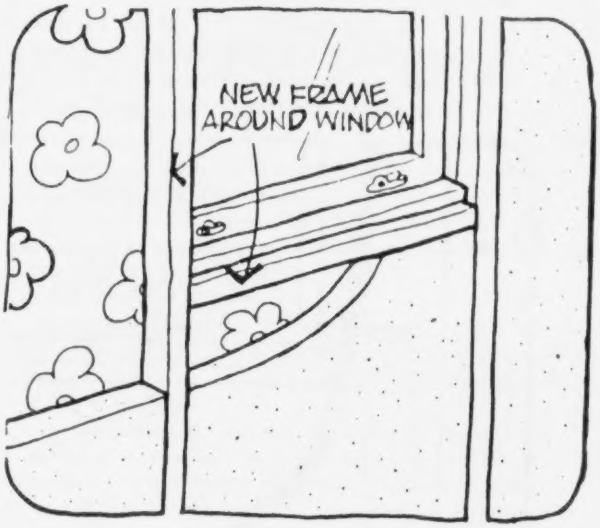
— when installing a separate polyethylene vapor barrier, unroll the sheet across the entire wall area, including window and door openings. These can be cut out later.

— make sure the insulation and barrier extend behind any pipes, electrical boxes, etc., such that these obstructions are on the warm side of the insulation. This may be difficult when building new inside walls. Electrical boxes may be moved into the new wall by a qualified tradesman or they might simply be inactivated and left on the cold side. Pipes are more difficult. If there are any in your existing wall (follow them up from the basement and down from the bathroom and kitchen) they could freeze and burst if left outside the insulation. Try to somehow get behind them, rather than in front. **If this isn't possible, then don't insulate using the new wall approach.**


COVER WITH VAPOR BARRIER
STUFF ALL CRACKS AROUND WINDOWS AND DOORS

— If you are rebuilding the exisiting wall, be sure to stuff all cracks around doors or windows with insulation or oakum (a material used specifically as a filler, available from your building materials suppler). Cover the cracks with a vapor barrier. If installing a new wall, frame around the windows and doors as illustrated.

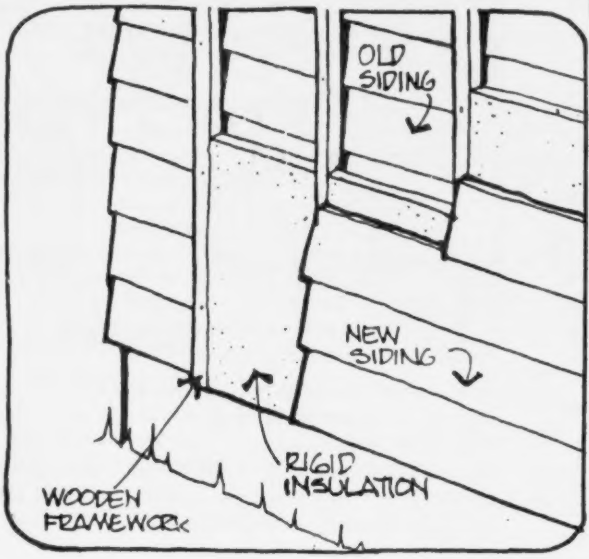
For non-standard stud spaces, cut the insulation (if the batt type is used) and any attached vapor barrier to about an inch wider than the space to be filled.



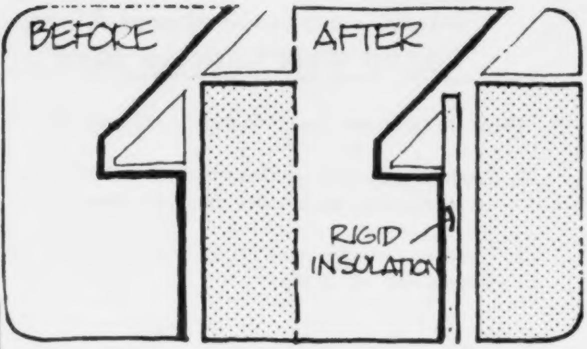
Option F: Insulate Outside

If you are installing new siding on the house in any case, it may be worthwhile to install polystyrene over the old siding, but under the new. A few points to keep in mind:

- extruded is the best option but a high density expanded polystyrene will be satisfactory.
- a wooden framework should be built over the entire outside wall to position the insulation and support the new siding.
- no vapor barrier should be added.



- unless the old siding supplies a good surface for glueing, the polystyrene should be nailed in place.



- the insulation should be extended right to the top of the wall, which may require going up into the eaves, as illustrated.
- if this does not prevent water from getting in between the insulation and the siding, then you must add "flashing" at the top of the insulation for this precise purpose. Consult with your building materials supplier.

ENERGY CONSERVATION BULLETIN 1.2C.1
How To Insulate (Floors and Basements)

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

There are two cases where it's good to insulate your floor:

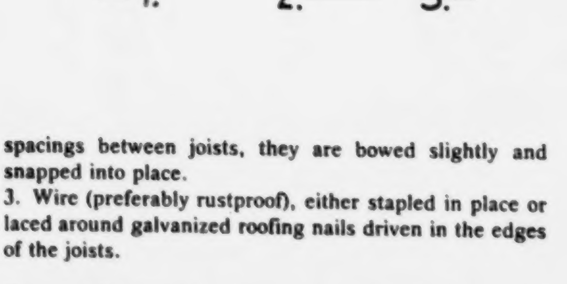
1. You have a crawl space that you can't seal off in winter — for example, your house stands on piers:
2. You have a garage, porch, or other cold unheated space with heated rooms above it:

FLOOR INSULATION — GENERAL — Warm side vapor protection is recommended.

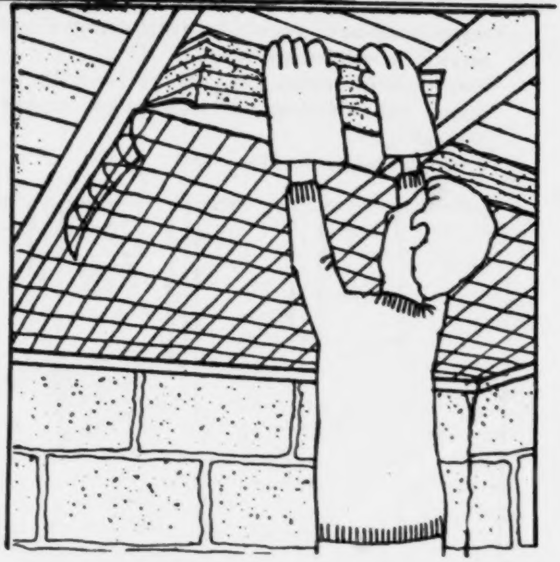
Place the insulation with the vapor barrier facing up in all applications except where a vapor barrier paper is used in place of the building paper over the sub floor. Only in this application may the vapor barrier face down.

Typical methods of supporting floor insulation are shown below.

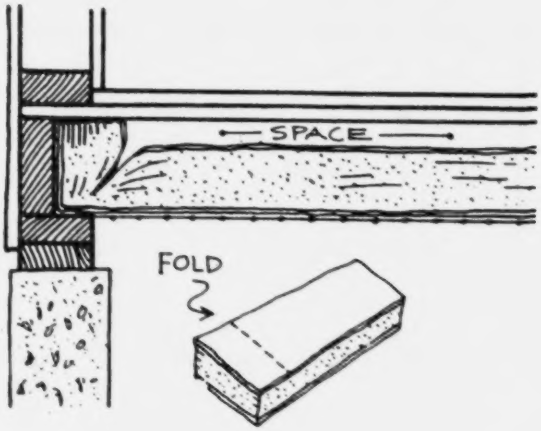
1. Chicken wire stapled to the edges of the joists, supporting the insulation above.
2. Commercially available fasteners made of heavy gauge wire, pointed at both ends. Slightly longer than the spacings between joists, they are bowed slightly and snapped into place.
3. Wire (preferably rustproof), either stapled in place or laced around galvanized roofing nails driven in the edges of the joists.



Reversed flange material may be used as floor insulation and may be stapled from below. If the vapor permeable face toward the crawl space is non-reflective, additional support may be required.



Start at a wall at one end of the joists and work out. Staple the wire to the bottom of the joists, and at right angles to them. Slide batts in on top of the wire. Work with short sections of wire and batts so that it won't be too difficult to get the insulation in place. Plan sections to begin and end at obstructions such as cross bracing.



Buy insulation with a vapor barrier, and install the vapor barrier facing up (next to the warm side) leaving an air space between the vapor barrier and the floor. Get foil-faced insulation if you can; it will make the air space insulate better. Be sure that ends of batts fit snugly up against the bottom of the floor to prevent loss of heat up end. Don't block combustion air openings for furnances.

How To Insulate (Basement)

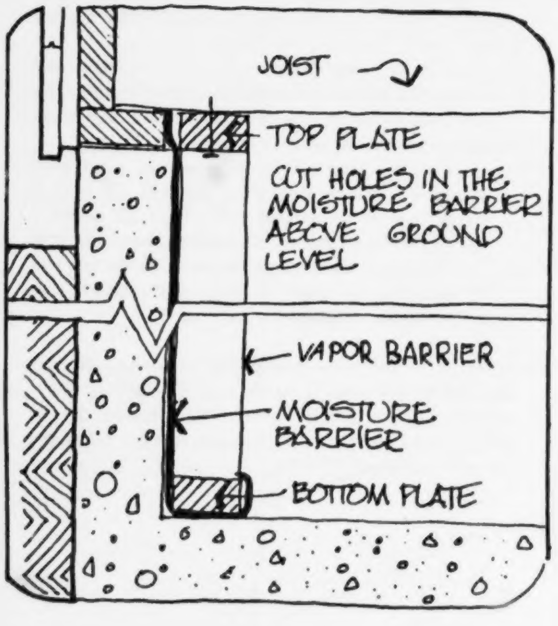
1.2C.2

BASEMENT INSULATION —

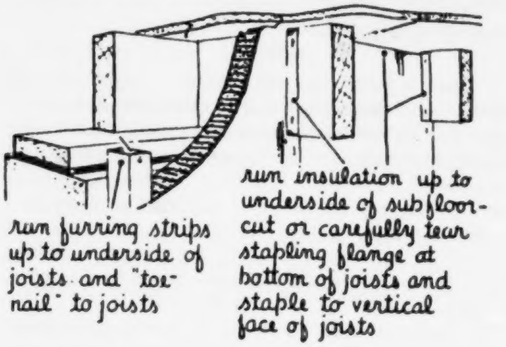
If you have a basement that you use as a living or work space and that has air outlets, radiators, or baseboard units to heat it, you may find that it will pay to add a layer of insulation to the inside of the wall.

Finish with wallboard or panelling. Basement walls are readily insulated by fastening furring strips vertically against the walls, and fitting batt or blanket insulation between them. Staple the flanges of the insulation to the furring strips just as though they were regular studs.

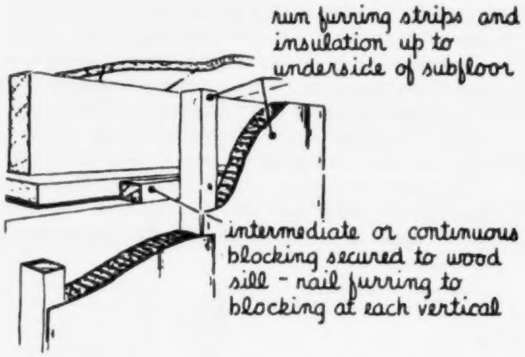
If the walls ever become damp, then the portion below ground should, as a minium, be treated with water-proofing chemical before proceeding. Even better, cover that same portion with a 2 mil polyethylene moisture barrier. The easiest way to install such a barrier is to attach the polyethylene to the header joist at the top. The portion of the barrier above ground can then be partially cut away to allow any moisture which might become trapped in the insulation to escape. Next, extend the sheeting right to the floor, such that the bottom edge stretches under the bottom plate of the framework, then back up to attach to the top of the place, as shown.


JOIST
TOP PLATE
CUT HOLES IN THE MOISTURE BARRIER ABOVE GROUND LEVEL
VAPOR BARRIER
MOISTURE BARRIER
BOTTOM PLATE

The figure below shows how furring strips can be attached at the top of walls parallel to the floor joists above.


run furring strips up to underside of joists and "toe-nail" to joists
run insulation up to underside of subfloor-cut or carefully tear stapling flange at bottom of joists and staple to vertical face of joists

The figure below shows how the tops of furring strips can be attached to the joists themselves when walls run at right angles to the joists.


run furring strips and insulation up to underside of subfloor
intermediate or continuous blocking secured to wood sill - nail furring to blocking at each vertical

The bottom of furring strips must also be fastened, either to the walls by drilling and inserting fiber or lead plugs to hold a nail or screw through the furring strip, or by attaching a plate to the floor at the bottom of the walls by similar means and toe-nailing the bottom of the furring strips to it. The plate and the furring strip should be of the same depth. The insulation between the furring strips should be fitted snugly against the sub-floor at the top, and against the basement floor or plate at the bottom.

Where all the walls of a basement area are insulated, it is not necessary to insulate the ceiling above that area, but any portion of the basement without complete wall insulation should have the ceiling above that area insulated.

ENERGY CONSERVATION BULLETIN 1.2C.3

How To Insulate (Outside of the Basement)

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

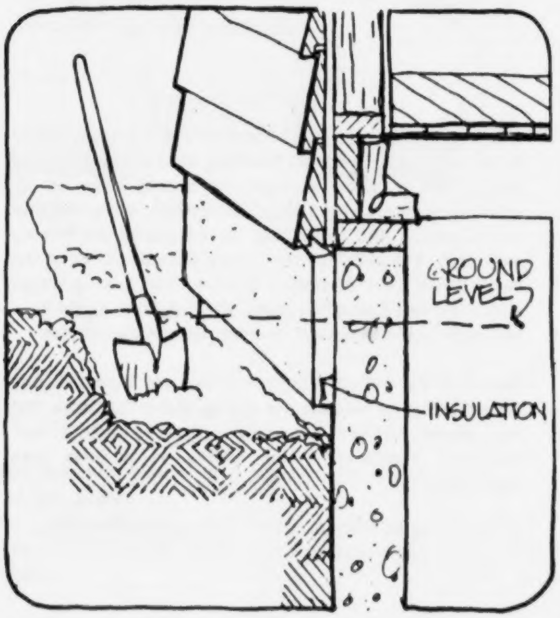
TYPE OF INSULATION

There is really only one choice — rigid extruded polystyrene. This product must be distinguished from the white board which is commonly called "styrofoam." This is an incorrect name — the proper name is polystyrene "beadboard." The term "Styrofoam" is a registered trade mark which properly refers to a particular company's version of extruded polystyrene. This product is blue.

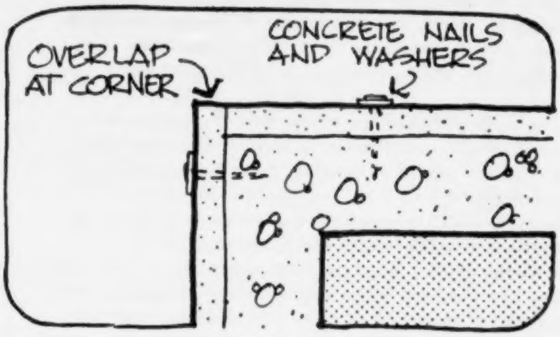
Extruded polystyrene not only has a high insulating value, but has a very high resistance to water absorption. As such, it is well suited to this purpose.

The insulation used should be at least 2 inches thick, and the horizontal section should be at least 2 feet wide. Even better would be a 3 inch thickness and a 3 to 4 foot width. The decision about what size to use should be based upon the climate and upon your personal finances.

1) **Digging the hole:** The vertical piece of insulation should extend a minimum of 12 inches into the ground. The second piece should be sloped towards the building (to promote drainage through the unfrozen soil adjacent to the basement wall) such that it drops about 2 inches for 2 foot piece of insulation or 3 inches for a 3 foot one. In short, you could be digging between 9" and 12" deep around your entire house — a big job. Don't make it bigger by oversizing your hole. You may even want to have it done by a contractor with the appropriate machinery!



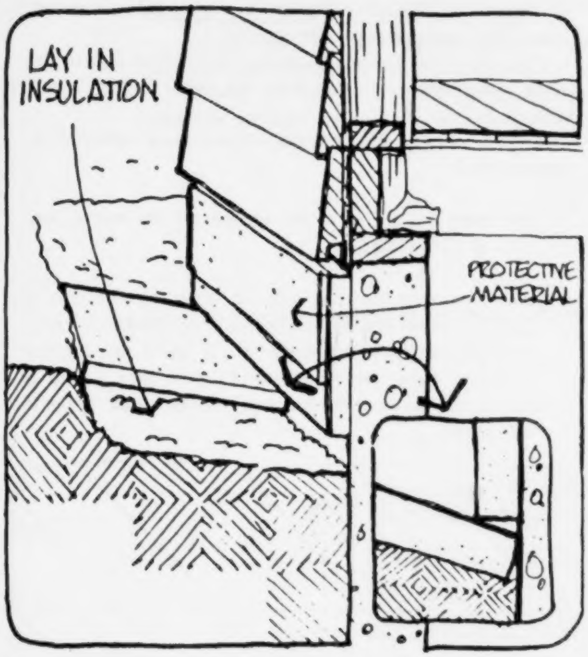
2) Apply the vertical polystyrene first, attaching it to the wall with concrete nails driven through a washer on the outer surface of the polystyrene. This job will be made easier if you drill small guidance holes for the nails beforehand. Overlap the insulation at corners.



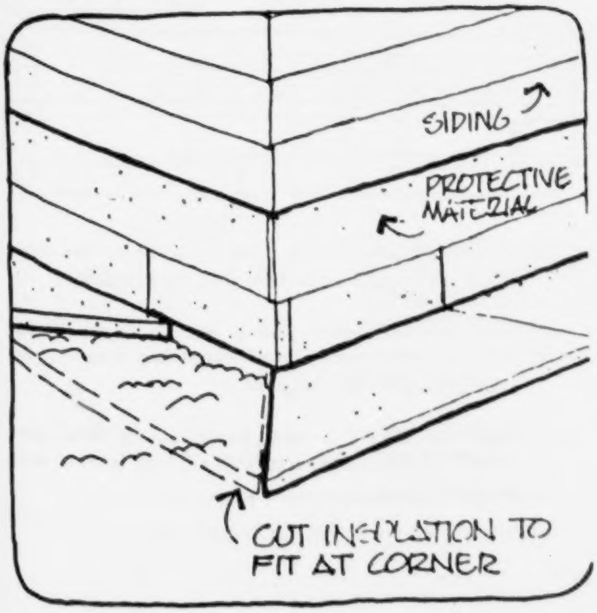
3) The exterior protection is applied next, from the top of the insulation to a point about 4 inches below ground level:
   a) if using the latex based stucco (the easiest and cheapest), simply follow the directions supplied by the manufacturer. The application is a two-stage process requiring no special skills.
   b) if using the asbestos board, you may want your dealer to cut it to size, since the material is rock hard. It must be applied using nails, as outlined above for the insulation. Remember, however, that the flashing at the top and the soil at the bottom will help to keep the board in place, so the nailing can be minimal.

4) Level off the soil in the hole so that it slopes uniformly down to the low point. A handy way of achieving this is to have a 2 x 4 of appropriate length handy. Simply drag it along the bottom of the hole, leveling off all the uneven sections.

5) Lay the insulation on the ground in such a way that it butts tightly against both the basement wall and the underside of the vertical polystyrene, as detailed in the inset.



6) At the corners, cut the insulation specially to fill the entire space, as shown.



7) Place the polyethylene plastic sheeting against the protective board and the insulation. It need not be held securely in place. Refill the hole, very gently at first so as to not damage the insulation — or the polyethylene. **Make sure the ground, when the hole is finally filled, slopes away from the house.** This will encourage drainage away from the insulation, as will the addition of eave troughing. It is important not to direct excess water towards the foundation.

8) Apply the flashing according to the manufacturer's instructions. Remember that it must be applied so as to prevent any water runoff from getting in behind the insulation.

9) The filled hole may be covered with any type of surface — patio stones, grass, a garden, or whatever you please. Shrubbery with deep roots should, however, be avoided.

10) If insulation is necessary inside, between the joists, then apply it as shown for basements. Pay particular attention to keeping the vapor barrier tight. For this purpose, a separate polyethylene barrier is preferable to the type attached to the batts.

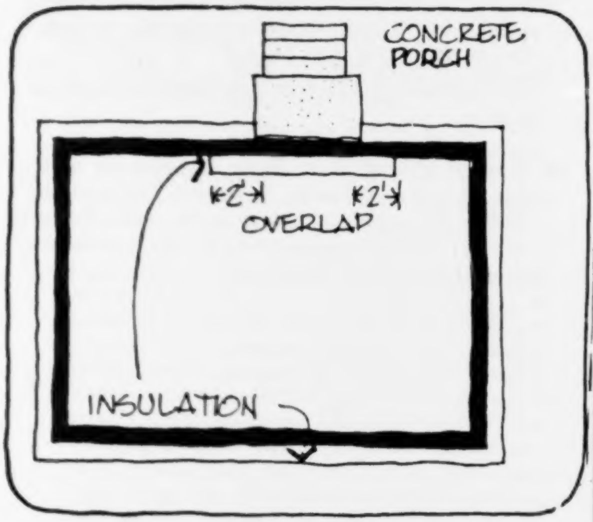
How to Insulate (Crawl Spaces)

1.2D.1

How To Insulate Heated Crawlspace

1) Insulate the outside wall exactly as directed for the outside basement wall.

2) If outside obstructions (a porch, a paved driveway, etc.) make it impossible to completely encircle the crawl space from the outside of the house, then the inside of the wall may be insulated at those points. Make sure the inside and the outside portions overlap by at least 2 feet, as illustrated.



The insulating material to use is extruded polystyrene. It should be applied in the same manner outlined for inside the basement. The job will be tricky in such cramped quarters! **In particular, remember the gypsum covering for the insulation — you'll have a fire hazard if you forget.**

3) If there is no vapor barrier on the crawl space floor, add one. The barrier should be protected by covering it with a 2 inch layer of sand.

4) If your crawl space doesn't open into a full basement it should have summer ventilation (about one square foot for every 500 square feet of floor space). Make sure these vents are closed and well sealed each winter!

How to Insulate Unheated Crawlspace

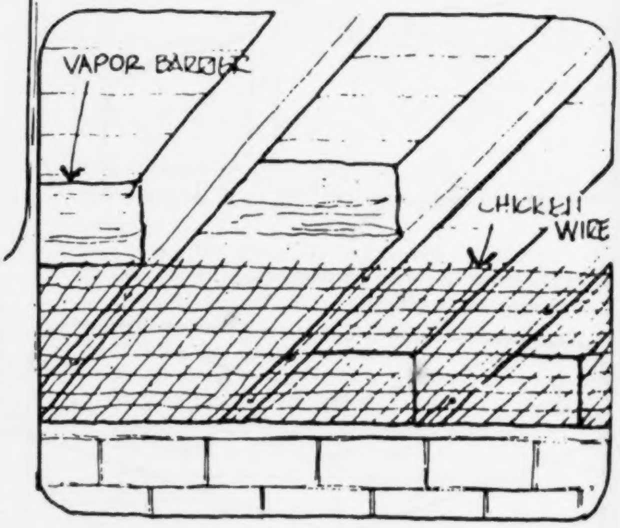
This approach should only be taken when the crawl space is moist enough to require ventilation all year round, even with a vapor barrier on the ground.

This job requires the use of batt or blanket insulation, most conveniently the type with the vapor barrier already attached.

A few points of general importance should be summarized:

1) The vapor barrier is to be applied on the warm (top) side of the insulation.

2) The insulation may be held in place by the use of building paper stapled to the joists, by chicken wire, or any other supporting material. If batts are applied separately from the vapor barrier, then they should be held firmly against the barrier, leaving no air space in between.



3) If there are any heating ducts or pipes in the crawl space, be sure to wrap them with duct insulation.

4) Make sure the crawl space is adequately ventilated. You should have at least one square foot of venting for each 500 sq. ft. of floor area.

5) Make sure there is a vapor barrier on the crawl space floor. It should be covered with a 2 inch layer of sand for protection.

ENERGY CONSERVATION BULLETIN 1.3.1
Insulation “R Values

Intermountain Rural Electric Association **303 794 1535**
2100 West Littleton Blvd **Littleton, Colo 80160**

An "R" value is a number indicating how much resistance insulation presents to heat flowing through it. Generally, the higher the "R" value, the more effective the insulation. Consumers should pay more only for a higher "R" value.

To help the consumer guard against dishonest contractors or salespeople who overstate the "R" value of an insulation product, outlined following are the current insulating materials:

	APPROXIMATE R-VALUE PER INCH
LOOSE FILL INSULATION	
Glass fiber	2.7 - 3.5 (pouring) 2.4 - 2.8 (blowing)
Cellulose fiber (2.1 to 2.3 lbs. density)	3.2 - 3.5
Mineral fiber* (2.0 - 5.0 lbs. density)	2.7 - 3.6 (pouring) 2.6 - 3.2 (blowing)
Vermiculite (expanded mica 7 lbs. density)	2.1 - 2.5
Loose polystyrene (shredded or beads)	3.0 - 3.3
Wood shavings	2.4
Wood wool (available in only some localities)	3.0
BATT OR BLANKET TYPE INSULATION	
Glass or mineral fiber batts	2.9 - 4.0
RIGID BOARD	
Extruded polystyrene (Roofing material, blue)	4.3 - 5.0
Expanded polystyrene "Beadboard" (white)	3.4 - 4.2
Phenolic foam board	4.2
Polyurethane slabs	5.0 - 6.0
"FOAMED IN PLACE"	
Ureaformaldehyde	4.3 - 4.9
Polyurethane foam	4.7 - 5.0

Any claim of an "R" value above the maximum design standard should be highly suspect.

Make sure you buy loose fill insulation by the bag and not by the inch. A contract should state how many bags are needed to bring the attic to a certain R-value, based on manufacturers specifications, which usually appear on a coverage chart right on the insulation bag. The depth frequently referred to is a minimum depth after the material settles. Make sure the correct number of bags are installed, even if you have to stand next to the truck and count them as they are stuffed into the blowing machine.

ENERGY CONSERVATION BULLETIN 1.4.1
Caulking and Weather Stripping

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

Infiltration of outside air is a major drain on energy in the home. During the winter the incoming air, which may already have a low moisture content, must be heated, and this tends to further reduce the relative humidity in the house, creating a dry air problem. In the summer the incoming air must be cooled and usually dehumidified.

Weatherstripping and caulking play an important part in reducing infiltration. Wind can cause a buildup of pressure on a portion of the house, forcing air through even the smallest cracks. If a window is not properly weatherstripped, it may even be possible to see the curtains move when there is a heavy wind. (When the wind velocity is doubled, the air leakage increases about 4 times.) Since nearly all building materials expand and contract with changes in weather, enough clearance must be allowed for this when constructing the house. This expansion space must then be closed with some form of weatherstripping or caulking. If a door must be moved regularly, weatherstripping is usually used to seal the crack. If the crack is between two fixed portions of the house, then caulking is forced into the joint to close it.

CAULKING

If there is a gap where two materials meet, such as siding and window trim, or corner trim, any cracks must be caulked. This is primarily to keep water from penetrating the structure of the house, but it also helps to prevent air infiltration. Caulking works like chewing gum in any crack or opening to prevent wind and water penetration. The ideal caulking will adhere to both sides of the opening to be closed and remain resilient to permit movement between the two materials without cracking. Inexpensive caulking may be able to withstand only minor expansion or compression before it fails and cracks. Good caulking may withstand a great deal of expansion or contraction before failure.

Caulking should also be used to close any cracks in masonry construction, either in the siding or foundation. In brick masonry construction there are often weep holes left in the vertical mortar joints in the bottom row of bricks to permit any moisture that penetrates the wall to drain out.

Do not caulk or block the weep holes in any way. If there seems to be an air infiltration problem, a length of fiberglass rope can be stuffed into the weep hole, which will effectively block air circulation, but will withdraw any water from behind the brickwork like a wick. If the prime window in the house is relatively loose, it may be simpler to caulk the storm sash into place rather than to weatherstrip the prime one. However, in no case should the bottom of a combination storm-screen sash be caulked. When the storm panel is raised and the screen is in place, a blowing rain will penetrate through the screen, and if the bottom of the sash is caulked, the water will accumulate on the windowsill and run into the house. Most such storm-screen combinations have holes along the bottom edge to allow for drainage. They should never be plugged.

It should also be noted that caulking the storm sash into place may cause problems with condensation on the inside surface of the storm window if the storm sash is tighter than the prime one. The cure in this case is to make the prime sash tighter so that water vapor does not leak past the prime sash.

If windows will not be opened during the heating season, a special type of caulking, in the form of a coiled string, is available for one-season use, and it may easily be stripped off in the spring. This caulking cord is relatively inexpensive and easy to handle. It is applied with the fingers and cut with scissors.

An alternative to this type of caulking is the use of masking tape, either on the inside or outside of the window, for those windows that will not be operated during the heating season. Fabric-backed heating duct tape may be more suitable than masking tape, since it has less tendency to leave an adhesive on the window trim when it is removed.

Caulking compound is available in these basic types:

1. Oil or resin base caulk; readily available and will bond to most surfaces — wood, masonry and metal; not very durable but lowest in first cost for this type of application.
2. Latex, butyl or polyvinyl based caulk; all readily available and will bond to most surfaces, more durable, but more expensive than oil or resin based caulk.
3. Elastomeric caulks; most durable and most expensive; includes silicones, polysulfides and polyurethanes; the instructions provided on the labels should be followed.
4. Filler; includes oakum, caulking cotton, sponge rubber, and glass fiber types; used to fill extra wide cracks or as a backup for elastromeric caulks.

CAUTION: Lead base caulk is not recommended because it is toxic. Many states prohibit its use.

Estimating the number of cartridges of caulking compound required is difficult since the number needed will vary greatly with the size of cracks to be filled. Rough estimates are:

½ cartridge per window or door
4 cartridges for the foundation sill
2 cartridges for a two story chimney

If possible, it's best to start the job with a half-dozen cartridges and then purchase more as the job continues and you need them.

The seal between glass and its wood frame should be tight. Check out your glazing carefully and be certain that all the seals are intact without cracks or missing sections. If not they need repair. For this you should use putty or glazing compound, on the other hand, lasts longer and stays semi-soft and usable for a longer period of time. Both can be applied with a putty knife, after removing the old putty! Be sure to firmly press the compound into the crack for a good seal.

WEATHERSTRIPPING

There are essentially two types of weatherstripping: one which depends upon a mechanical interlocking of two parts, and the other which depends upon the compression of some resilent material between one or two moving surfaces.

Mechanical weatherstrips are most often used on doors. They consist of two parts, each being hook-shaped, one of which is installed on the door frame while the other is notched into the door edge. The second type mounts on the door stop, with the interlocking piece mounted on the door face. As the door closes, these hookshaped pieces interlock with a spring action, preventing air passage. A similar arrangement is often used on door bottoms, where one hook is part of a metal threshold and the other attached to the bottom of the door.

Another type of weatherstrip that uses both mechanical and compression action is used on the bottom of doors that must open over thick carpeting. In this case a compression-type weatherstrip is fastened to the bottom of the door at a point high enough to clear the rug, and it is lowered by mechanical action as the door approaches the threshold, forcing the felt, vinyl, or rubber strip down onto the threshold as the door reaches the closed postion.

The longest lasting weatherstrip is spring bronze. This comes in various shapes to fit almost every type of sliding or closing door but it is the most expensive and difficult material to install. Wind may also cause the strip to "hum" under certain conditions.

Where two surfaces must remain in close contact but still slide, the most popular type of weatherstrip is a wool or synthetic pile. This is the type used by most manufacturers for factory weatherstripping of windows. These synthetic piles wear well and remain springy for many years.

Probably the most popular type of weatherstrip used by do-it-yourselfers is foam plastic, either adhesive-backed or attached to a wooden strip. Foam rubber is somewhat more durable than plastic, but takes more force to compress and does not compress into as small a space as does foam plastic. If there are considerable variations in the space to be closed, foam plastic may be superior. A variation of this type of weatherstrip is vinyl or rubber tubing, sometimes foamfilled, which is compressed between two meeting surfaces.

The cheapest variety of compression weatherstrips is felt, but it has the least amount of resilience to accommodate variations in the gap to be filled. Also felt weatherstripping has little resistance to abrasion and is therefore used where two materials come together in compression rather than in a sliding fit.

Molded rubber or plastic strips are often used on door bottoms and thresholds. In the case of the threshold it is restrained at the edges with the center bulging up to meet the door. In the case of vertical operation, such as garage doors, the molded strip is nailed to the bottom of the garage door with the projecting edges coming down and conforming to the garage floor.

One very efficient weatherstrip for specialized application is the vinyl strip with enclosed magnets that snap the strip against a metal door. This is the type commonly used on refrigerator doors and is often standard equipment on metal-clad residential doors.

A fringe benefit that occurs with the application of tight-fitting weatherstrips on windows and doors is the reduction of outdoor dust and dirt that is blown into the house. Another fringe benefit is that street and traffic noise are reduced to some extent.

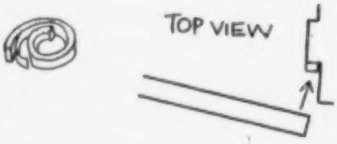
How To Weatherstrip

Any crack around a window or door that is loose enough for a dollar bill to be inserted and pulled out needs weatherstripping. You can weatherstrip your doors even if you're not an experienced handyman. There are several types of weatherstripping for doors, each with its own level of effectiveness, durability and degree of installation difficulty. Select among the options given the one you feel is best for you. **The installations are the same for the two sides and top of a door,** with a different, more durable one for the threshold.

1. Adhesive backed foam:

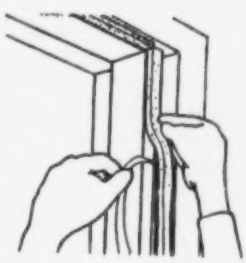
Tools

Knife or shears,
Tape measure



Evaluation — extremely easy to install, invisible when installed, not very durable, more effective on doors than windows.

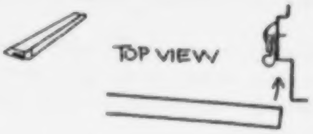
Installation — stick foam to inside face of jamb.



2. Rolled vinyl with aluminum channel backing:

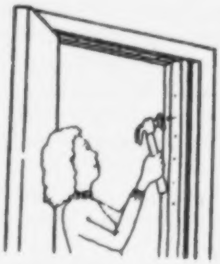
Tools

Hammer, nails,
Tin snips
Tape measure



Evaluation — easy to install, visible when installed, durable.

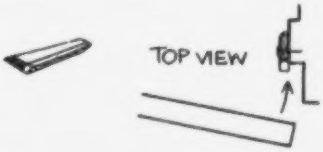
Installation — nail strip snugly against door on the casing



3. Foam rubber with wood backing:

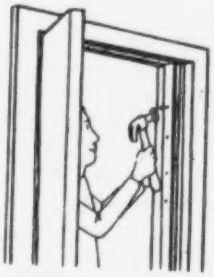
Tools

Hammer, nails,
Hand saw,
Tape measure



Evaluation — easy to install, visible when installed, not very durable.

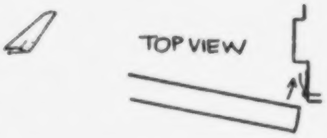
Installation — nail strip snugly against the closed door. Space nails 8 to 12 inches apart



4. Spring metal:

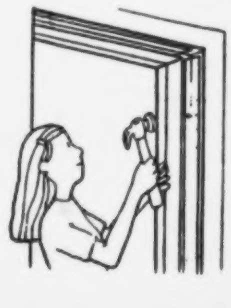
Tools

Tin snips
Hammer, nails,
Tape measure



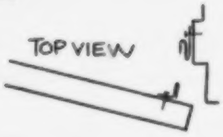
Evaluation — easy to install, invisible when installed, extremely durable.

Installation — cut to length and tack in place. Lift outer edge of strip with screwdriver after tacking, for better seal.



Note: These methods are harder than 1 through 4.

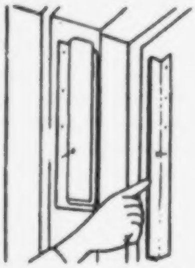
5. Interlocking metal channels:



Tools

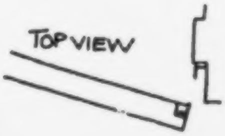
Hack saw,
Hammer, nails,
Tape measure

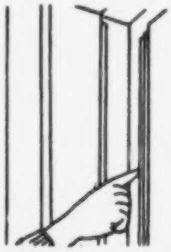
Evaluation — difficult to install (alignment is critical), visible when installed, durable but subject to damage, because they're exposed, excellent seal.



Installation — cut and fit strips to head of door first; male strip on door, female on head; then hinge side of door: male strip on jamb, female on door; finally lock side on door, female on jamb.

6. Fitted interlocking metal channels: [J-Strips]

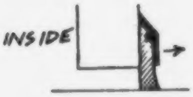




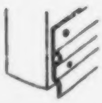
Evaluation — very difficult to install, exceptionally good weather seal, invisible when installed, not exposed to possible damage.

Installation — should be installed by a carpenter. Not appropriate for do-it-yourself installation unless done by an accomplished handyman.

7. Sweeps:



Tools

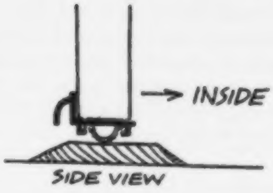


Screwdriver,
Hack saw,
Tape measure

Evaluation — useful for flat threshholds, may drag on carpet or rug.

Installation — cut sweep to fit 1/16 inch in from the edges of the door. Some sweeps are installed on the inside and some outside. Check instructions for your particular type.

8. Door Shoes:

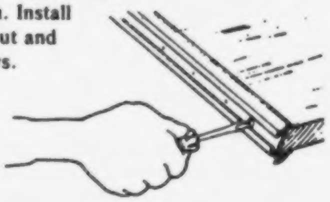


Tools

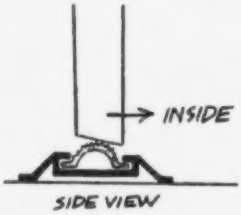
Screwdriver,
Hack saw,
Plane,
Tape measure

Evaluation — useful with wooden threshold that is not worn, very durable, difficult to install (must remove door).

Installation — remove door and trim required amount of bottom. Cut to door width. Install by sliding vinyl out and fasten with screws.



9. Vinyl bulb threshold:



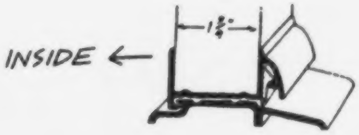
Tools

Screwdriver,
Hack saw,
Plane,
Tape measure

Evaluation — useful where there is no threshold or wooden one is worn out, difficult to install, vinyl will wear but replacements are available.

Installation — remove door and trim required amount off bottom. Bottom should have about 1/8" bevel to seal against vinyl. Be sure bevel is cut in right direction for opening.

10. Interlocking threshold:

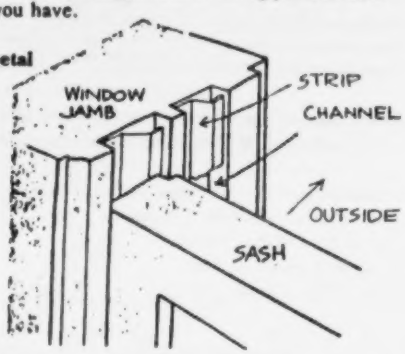


Evaluation — very difficult to install, exceptionally good weather seal.

Installation — should be installed by a skilled carpenter.

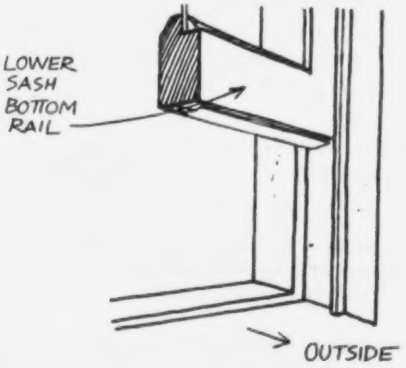
Weatherstripping is purchased either by the running foot or in kit form for each window. In either case you'll have to make a list of your windows, and measure them to find the total length of weatherstripping you'll need. Measure the total distance around the edges of the moving parts of each window type you have.

Thin spring metal



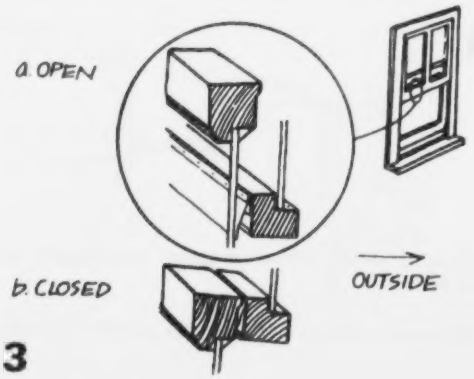
1

Install by moving sash to open position and sliding strip in between the sash and the channel. Tack in place into the casing. Do not cover the pulleys in the upper channels.



2

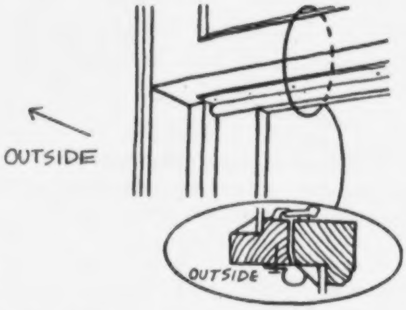
Install strips the full width of the sash on the bottom of the lower sash bottom rail and the top of the upper sash top rail.



3

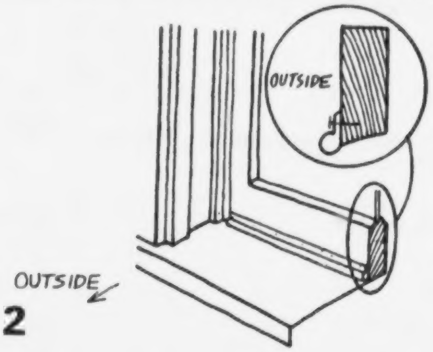
Then attach a strip the full width of the window to the upper sash bottom rail. Countersink the nails slightly so they won't catch on the lower sash top rail.

Rolled vinyl



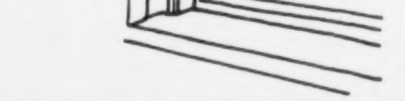
1

Nail on vinyl strips on double-hung windows as shown. A sliding window is much the same and can be treated as a double-hung window turned on its side. Casement and tilting windows should be weatherstripped with the vinyl nailed to the window casing so that, as the window shuts, it compresses the roll.



2

Adhesive-backed foam strip



Install adhesive backed foam, on all types of windows, only where there is no friction. On double-hung windows, this is only on the bottom (as shown) and top rails. Other types of windows can use foam strips in many more places.

If storm windows are of the type that are completely separate from the prime window, weatherstripping is less important because there is enough of a double seal against outside air — once by the storm window and once by the prime window.

ENERGY CONSERVATION BULLETIN 1.5.1

Windows and Doors

Intermountain Rural Electirc Association 303 794 1535
2100 West Littleton Blvd. Littleton, Colo 80160

Windows and doors can be big energy-wasters. There are three reasons:

1) Glass itself is a highly heat conductive material. Similarly, many wooden doors are highly heat conductive.
2) Doors and windows that open necessarily have cracks all around them.
3) Air can pass through the joints around window and door frames if they aren't tightly sealed.

The last two problems can be overcome by installing weatherstripping and caulking. This paper deals with the first problem — the windows and doors themselves.

A single pane of glass has an R-value of about 1. So it loses about 12 times as much heat as the same area of properly insulated wall. Storm windows, or double glazing, will reduce the heat that is needlessly lost through the windows in your house by almost half! They will also make your house more comfortable by reducing drafts and increasing the temperature of the interior window, which would otherwise produce a "cold feeling."

Storm windows vary widely in design, durability, ease of use, and cost. They range from temporary plastic sheets to custom-made permanent installations.

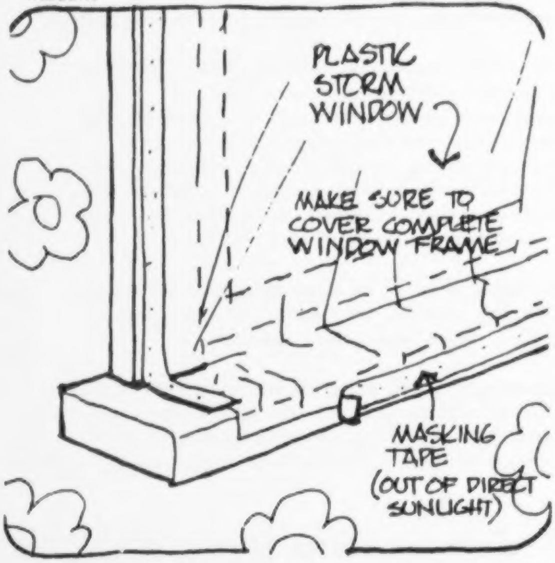
All are about equally effective. The more expensive ones are more attractive and convenient.

If you have any windows with just a single pane of glass, then you may choose one of four ways to upgrade them:

I—Plastic Storm Windows

Installation of plastic sheeting over the window is a very inexpensive and easy way to improve the heat retention of your home. The plastic will be less durable than glass, will have to be re-installed each year, and will reduce visibility from the window somewhat. Nevertheless, it is an effective "storm window."

Six mil polyethylene should be used. It should be installed inside the window since fewer moisture problems will arise, the plastic will be protected from the elements, and it is most easily installed this way. It should be attached to the main window frame so that it will block airflow that leaks around the moveable parts of the window.


PLASTIC STORM WINDOW
MAKE SURE TO COVER COMPLETE WINDOW FRAME
MASKING TAPE (OUT OF DIRECT SUNLIGHT)

A continuous strip of good quality masking tape around the entire frame is all that is needed to hold the plastic into place (cheaper brands of tape may lift the paint when eventually removed). Position the tape so that it is not exposed to the direct light of the sun.

Rigid, clear 1/8-inch acrylic plastic (Plexiglas, Lucite) sheets are available for as little as $1 a square foot, cut to size. If you edge it with narrow, adhesive-backed foam rubber strips, it can be placed over many kinds of windows with screws and without frames. It is especially handy for fixed windows. The plastic is more resistant to heat flow than glass.

This plastic should be protected from scratches and not washed with window cleaners containing ammonia; mild detergent is recommended.

II—Single Pane Storm Windows

Storm window suppliers will build single pane storm windows to your measurements that you then install yourself. Another method is to make your own with aluminum do-it-yourself materials available at most hardware stores.

Determine how you want the windows to sit in the frame. Your measurements will be the outside measurements of the storm window. Be as accurate as possible, then allow 1/8" along each edge for clearance. You'll be responsible for any errors in measurement, so do a good job.

When your windows are delivered, check the actual measurements carefully against your order.

Install the windows and fix in place with moveable clips so you can take them down every summer.

Single pane storm windows aren't as expensive as the double-track or triple-track combination windows. The major disadvantage of the single pane windows is that you can't open them easily after they're installed.

Frame finish: A mill finish (plain aluminum) will oxidize quickly and degrade appearance. Windows with an anodized or baked enamel finish look better.

Weatherstripping: The side of the aluminum frame which touches the window frame should have a permanently installed weather strip or gasket to seal the crack between the window and the single pane storm window frames.

III—Combination Storm Windows

Triple track, combination (windows and screen) storm windows are designed for installation over double hung windows. They are permanently installed and can be opened any time with a screen slid into place for ventilation.

Double-track combination units are also available and they cost less. Both kinds are sold almost everywhere, and can be bought with or without the cost of installation.

These permanent storms are more convenient than the removable type, but also more expensive. Make your decision accordingly. Regardless of which of the two types you choose, shop around a bit to make sure you get well made windows. Look at the quality of hardware used, quality of the weatherstripping, strength of joints, and so on. These windows are a long term investment. You may as well get the best.

You can save a few dollars (10% to 15% of the purchase price) by installing the windows yourself. But you'll need some tools: caulking gun, drill, and screw driver. In most cases it will be easier to have the supplier install your windows for you, although it will cost more. *

The supplier will first measure all the windows where you want storm windows installed. It will take anywhere from several days to a few weeks to make up your order before the supplier returns to install them.

Installation should take less than one day, depending on how many windows are involved. Two very important items should be checked to make sure the installation is properly done.

Make sure that both the window sashes and screen sash move smoothly and seal tightly when closed after installation. Poor installation can cause misalignment.

Be sure there is a tightly caulked seal around the edge of the storm windows. Leaks can hurt the performance of storm windows a lot.

NOTE: Most combination units will come with two or three ¼" dia. holes [or other types of vents] drilled through the frame where it meets the window sill. This is to keep winter condensation from collecting on the sill and causing rot. Keep these holes clear, and drill them yourself if your combination units don't already have them.

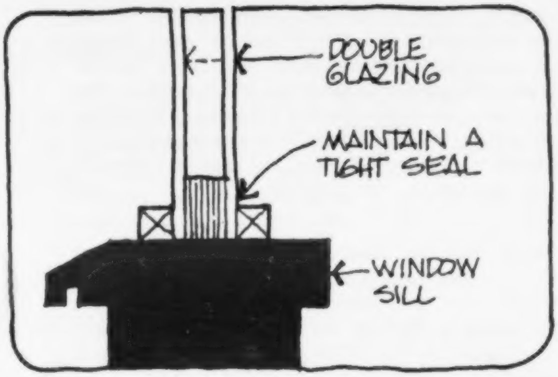
Frame finish: A mill finish (plain aluminum) will oxidize, reducing ease of operation and degrading appearance. An anodized or baked enamel finish is better.

Corner joints: Quality of construction affects the strength and performance of storm windows. Corners are a good place to check construction. They should be strong and air tight. Normally overlapped corner joints are better than mitered. If you can see through the joints, they will leak air.

Sash tracks and weatherstripping: Storm windows are supposed to reduce air leakage around windows. The depth of the metal grooves (sash tracks) at the sides of the window and the weatherstripping quality makes a big difference in how well storm windows can do this. Compare several types before deciding.

Hardware quality: The quality of locks and catches has direct effect on durability and is a good indicator of overall construction quality.

IV— Hermetically Sealed Double Glazing



This type of double glazing is simply a sealed unit of two panes of glass, approximately ¼ - ½'' apart, the gap being filled with absolutely dry air (or in some cases other gases). The seal around the glazing must remain perfectly air tight, since even the tiniest air leak will cause fogging inside the window.

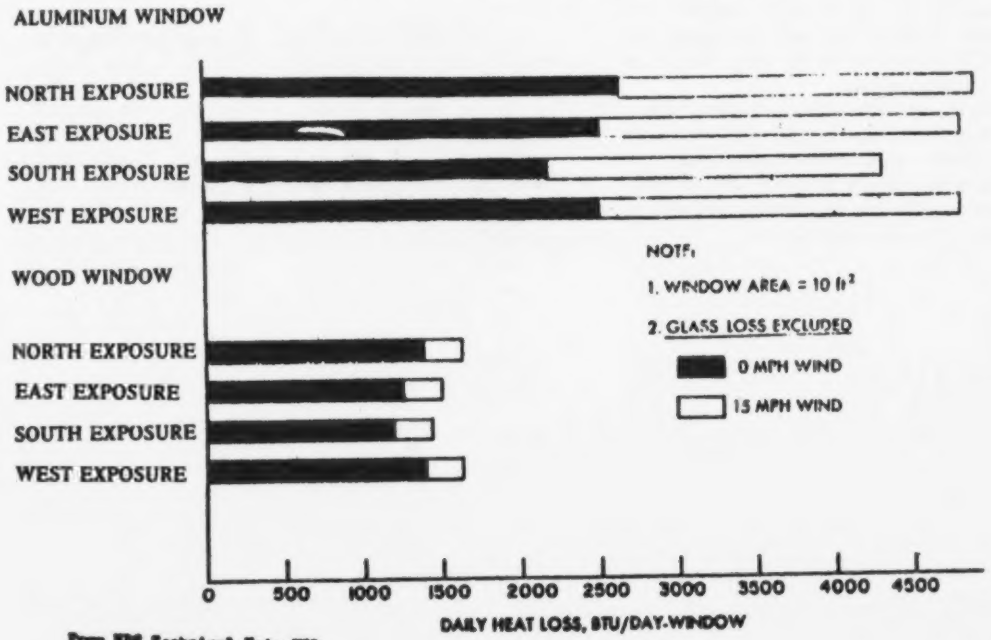
Since the cost of these windows is substantial, they are really only economical if you are planning to replace existing windows anyway.

V—Triple Glazing

In many colder parts of the world triple glazing is rapidly becoming more popular. It is more expensive but still may be worthwhile in most parts of Colorado. If you presently have only single glazing, adding a double glazed unit will decrease the heat lost through the windows by nearly two-thirds.

Similarly, if you presently have double glazing where the two panes of glass are close together (½'' or ¼'' apart), you may want to add a separate single storm window for further comfort. A system of triple glazing will usually pay for itself, in decreased fuel bills, within 15 years (and often less!).

WINTER DAILY HEAT LOSS FOR WINDOW FRAME



From NBS Technical Note 789

Solar Heat Gain

A window, unlike a wall, can transmit sunlight into a room, then trap its heat. In many instances, this solar heat gain can exceed the window's total conductive heat loss for the day. Thus, the window can actually provide heat in winter! To take fullest advantage of this, south exposures should have the greatest window area, followed by east and west exposures, and the window area on north exposures should be minimized.

Shading

Shading windows during the summer can eliminate the need for air conditioning during much of the cooling season and drastically reduce the load on the air conditioner when it is required.

Shading is most effective if it occurs outside the window. If a window is totally shaded and air can circulate between the shading device and the glass, solar heat gain can be reduced by 80 percent. Examples of effective external shading devices include canvas awnings, operable shutters (the louvered-type permits concurrent shading and ventilation), commercial "solar screens" (a series of closely spaced aluminum slats), and not to be forgotten — trees (deciduous species don't shade the winter sun). Shading can also be accomplished architecturally as with roof overhangs or trellises, if possible, designed to admit the winter sun, which is lower on the horizon than the summer sun.

Decorative insulations are materials applied to the interior of a house for the purpose of conserving heat as well as making the home more attractive. The hanging of draperies can save a great deal of energy. Heavy draperies drawn fully across a window can reduce the heat loss in the winter by 25 percent. If, however, the draperies also cover a heat outlet, such as a convector, diffuser, or radiator, they could increase the heat loss by channeling warm air against the window. To retain heat and save energy, the warm air should be introduced on the room side of the drapery, not on the window side.

Dome draperies are available with an insulated lining, either of the foam or reflective type, and these are somewhat more effective than conventional drapes.

A tightly fitting window shade, venetian blind, or inside shutter can also reduce the heat loss through a window by about 25 percent.

If inside shutters are used to cover windows during cold weather, the portion of the shutter that faces the window can be lined with a thin decorative foam plastic board, which may double the insulating value of a window equipped with insulating glass or a storm window. The paper-covered foam-core board is available at art supply and advertising display outlets. The board can be covered with fabric or be papered, painted, and so on for a pleasing exterior appearance.

Closing draperies, shades, blinds, or shutters does lower the temperature of the glass and it may cause condensation or frost formation if the humidity in the house is high. In fact, the presence of condensation is a good measure of the effectivenss of this method of insulation.

Decorative window coverings should, of course, be opened when the sun strikes the window in order to obtain the maximum solar heat gain. Draperies, shutters, blinds, and shades should be closed at night and during periods of overcast sky or high winds.

In the summer this treatment of decorative window insulation should be reversed. The window should be covered when the sun strikes it, and the draperies should be opened at night to allow as much heat as possible to radiate into the cooler night air.

With heavy draperies you are no longer exposed to cold window surfaces. Heat radiation from the body to the window surface is reduced.

With heavy full-length draperies, cold air currents that seep through the windows are slowed by the drapery near the floor. Cold air drafts are less noticeable across the ankles when draperies are closed.

Though many people believe that wood paneling adds significantly to the insulating value of a wall, if the paneling is substituted for conventional drywall products, it has no greater insulating value than the product replaced. If wood paneling in installed over an existing wall finish, it will help to a small extent. Quarter-inch wood paneling has an R-value of approximately 0.25. This is less than 2 percent of the desirable R-value of a well insulated wall.

Doors

The first and foremost item to check with doors are the cracks around the frame. A ¼" crack along the bottom can lose as much heat as a 3" x 3" hole in your living room wall — and you would surely repair that!

Assuming that you have a tightly fitting door, you have two options to make it more weatherproof:

I—Replace The Door:

Many doors today are made by using a softwood frame covered on both sides by thin plywood. Similarly, some older ornate doors have just a thin panel separating the warm from the cold in places. Such doors offer little resistance to heat transfer, and could profitably be replaced by a good, solid insulated door of at least 2 inch thickness. If your doors are standardized sizes, it should be fairly easy to obtain what you need from your building supplier. It should pay for itself within 5-10 years.

II—Add Storm Doors:

Though noticeably less effective in reducing heat loss than installing an insulated door, storm doors are valuable additions. Since most contain a combined window and screen arrangement, they can be sealed in winter but opened for ventilation in the summer.

You can save a few dollars (10% to 15% of the purchase price) by installing doors yourself. But you'll need some tools: hammer, drill, screw driver, and weatherstripping. In most cases, it will be easier to have the supplier install your doors himself.

The supplier will first measure all the doors where you want storm doors installed. It will take anywhere from several days to a few weeks to make up your order before the supplier returns to install them. Installation should take less than one-half day.

Before the installer leaves, be sure the doors operate smoothly and close tightly. Check for cracks around the jamb and make sure the seal is as air-tight as possible. Also, remove and replace the exchangeable panels (window and screen) to make sure they fit properly and with a weather tight seal.

Door finish: A mill finish (plain aluminum) will oxidize, reducing ease of operation and degrading appearance. An anodized or baked enamel finish is better.

Corner Joints: Quality of construction affects the strength and effectiveness of storm doors. Corners are a good place to check construction. They should be strong and air tight. If you can see through the joints, they will leak air.

Weatherstripping: Storm doors are supposed to reduce air leakage around your doors. Weatherstripping quality makes a big difference in how well storm doors can do this. Compare several types before deciding.

Hardware quality: The quality of locks, hinges and catches should be evaluated since it can have a direct effect on durability and is a good indicator of overall construction quality.

Construction material: Storm doors of wood or steel can also be purchased within the same price range as the aluminum variety. They have the same quality differences and should be similarly evaluated. The choice between doors of similar quality but different material is primarily up to your own personal taste.

ENERGY CONSERVATION BULLETIN 1.6.1

Ventilation

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton Colo 80160

Attic Ventilation

It is important to close and seal tightly against air leakage from occupied spaces all openings into the attic. Keep outdoor air vents open in attics and crawl spaces in the winter time to prevent condensation of moisture in or on insulation or other building materials.

Due to the warmth and lighter weight of indoor air, as compared to that of the outdoor air in winter, there is a tendency for the air in the living space to flow upward into an attic if there are any openings through which it can do so. In the first place such flow represents a heat loss which may be considerable, in the second place, it conveys moisture from the occupied space into the attic where it might condense or deposit as frost which ultimately will melt and cause wetting.

Among openings through which such flow might occur are those around loosely fitting attic stairway doors, or pulldown stairways, penetrations of ceiling by electric light, or other fixtures, such as a ceiling fan used for summer cooling, or around plumbing vents or pipes, or air ducts which pass into the attic. In some cases the air spaces in interior partitions constitute paths by which indoor air can flow into the attic. In all cases, such openings should be sealed as tightly as possible to prevent upward air flow.

Ventilation above the insulation of the attic is necessary both winter and summer. In winter, the insulation keeps heat inside the living space below while the open vents let moisture vapor escape. In summer, the moving air lessens attic heat build-up.

Always provide at least two vent openings, located so that air can flow in one and out the other.

A combination of vents at the eaves and at the gable ends is better than gable vents alone. A combination of eaves vents and continuous ridge venting is best of all.

Here are the minimum amounts of attic vent area your home should have:

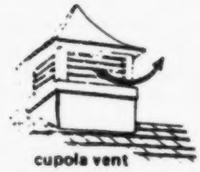
Combination of eaves vents and gable vents without a vapor barrier — 1 sq. ft. inlet and 1 sq. ft. outlet for each 600 sq. ft. of ceiling area, with at least half the vent area at the tops of the gables and the balance at the eaves.

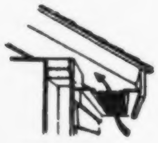
Gable vents only with a vapor barrier — 1 sq. ft. inlet and 1 sq. ft. outlet for each 600 sq. ft. of ceiling area.

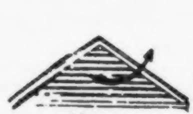
Gable vents only without a vapor barrier — 1 sq. ft. inlet and 1 sq. ft. outlet for each 300 sq. ft. of ceiling area.

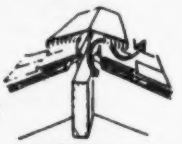
These recommended vent sizes are based on a completely open vent with no screen or louvers in front of it. Where vents are protected by screens or rain louvers, whether in attics or crawl spaces, the recommended size of the vent should be increased as follows:

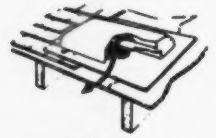
TYPE OF COVERING	SIZE OF OPENING
¼" hardware cloth	1 times net vent area
¼" hardware cloth and rain louvers	2 times net vent area
8-mesh screen	1¼ times net vent area
8-mest screen and rain louvers	2¼ times net vent area
16-mesh screen	2 times net vent area
16-mesh screen and rain louvers	3 times net vent area


cupola vent


eaves vent


gable vent


ridge vent


roof vent

Ventilation of an attic with outdoor air through the ventilating openings normally provided (total net area of openings equal to 1/300 of the attic floor area) is quite capable of expelling the moisture that might enter an attic from the occupied space if air leakage paths are moderately wellsealed. However, if leakage paths are excessive (that is, if the total area is greater than the attic floor area divided by 2,000) the capacity of the ventilating opening to remove moisture from the attic may be overtaxed at times of no wind. For this second important reason, leakage paths should be sealed as well as possible.

1.6.2

Crawl Space Ventilation

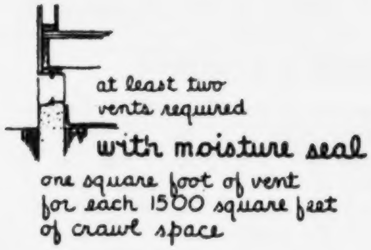
At least two vents, opposite each other, should be provided in an unheated crawl space.

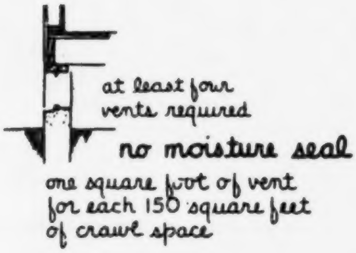
Basic minimum vent opening size, with moisture seal (4-mil-or-thicker polyethylene sheeting or 55-lb. asphalt roll roofing, lapped at least 3 inches) on the ground: 1 sq. ft. of vent for each 1,500 sq. ft. of crawl space area. Note that the addition of a ground moisture seal over the bare earth will markedly assist in keeping the crawl space humidity at a safe level.

Basic minimum vent opening size, without moisture seal: 1 sq. ft. for each 150 sq. ft. of area. Four vents, one of each of the four sides, are suggested.

If attic or crawl space vents are protected by screening or rain louvers, the basic opening size should be increased as shown in this table:

Type of Covering	Size of Opening
¼" hardware cloth	1x net vent area
¼" hardware cloth and rain louvers	2x net vent area
8-mesh screen	1¼ x net vent area
8-mesh screen and rain louvers	2¼ x net vent area
16-mesh screen	2 x net vent area
16-mesh screen and rain louvers	3 x net vent area


at least two
vents required
with moisture seal
one square foot of vent
for each 1500 square feet
of crawl space


at least four
vents required
no moisture seal
one square foot of vent
for each 150 square feet
of crawl space

If your crawl space is properly insulated, you can leave vents in this area open in the winter. If you don't have insulation in your crawl space, you can close off some of the vent openings in the winter (don't close them all). Make sure they are open again in the spring.

ENERGY CONSERVATION BULLETIN 1.7.1
Ventilation/ Vapor Barriers

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd. Littleton Colo 80160

Moisture Control

The major problem that could be associated with any retrofitting program is that of moisture control. A retrofitting job done properly will not increase the likelihood of moisture problems. However, if proper insulation practices are not followed, some damage to the insulation and perhaps to the house might result. It is, therefore, important to have an understanding of the principles outlined here before proceeding.

Warm air holds more invisible water vapor than cold air. If war air is chilled by meeting cold air or a cold surface, part of the vapor in the warm air is condensed into water.

This is the reason for coasters under iced drinks and why the inside of windows fog up or get when when outside temperatures fall sharply in humid climates.

When this happens within an outside wall or ceiling of a house, it is serious. The dampness can ruin insulation, and you know what trapped water can do to wooden beams, plaster and paint.

Instructions for installing insulation warn that the vapor barrier must be on the inside, toward the heat, but they seldom explain why. The barrier prevents the moisture-laden inside air from meeting cold air and condensing in the insulation or on the cold farther surface.

The first, and most important, step necessary to prevent this problem is humidity control.

Make sure the humidity in your house isn't too high. When this is coupled with the proper use of an air/vapour barrier and ventilation — both important parts of any retrofit program and of any house — no problems will arise.

Excessive interior humidity from household activities can be disposed of by kitchen,laundry and bathroom ventilating fans. The outlet of these fans should be vented to the outside of the home, not into the attic, and the vents should be provided with an effective back draft damper. In the kitchen, range hood fans (vented to the outside) are the most efficient way to ventilate because they trap and exhaust heat, odor, moisture and smoke before they can circulate in the room. The Small Homes Council-Building Research Council recommends that hood fan capacity should be 100 cubic feet (3 cu m) per minute for each lineal foot (30 cm) of hood length. For example, a 3-foot (90 cm) hood would require a 300 cubic foot (8.5 cu m) per minute fan.

Recommended inside humidity for varying outside temperatures.

Outside Air Temperature (°C)	Recommended inside humidity at 20°C(68°F)
-30 or below	15%
-30 to -24	20%
-24 to -18	25%
-18 to -12	35%
-12 and above	40%

In any case, if on cold days heavy consensation develops on the inside of double glazed windows, the humidity is too high (unless, of course, the double glazed window is itself "leaky." If it is, cold air sneaking in will produce condensation regardless of humidity levels. Weatherstrip and caulk that window until it is tight). If the humidity is too high, disconnect any humidifiers, cover bare earth floors of cellars or crawl spaces with polyethylene film and so on. Get the humidity down.

Quality of moisture added to the air by normal human activity

Activity	lbs. of moisture
Washing clothes, per week	4.0
Drying clothes by hanging on a line indoors, per week	26.0
Cooking and dishwashing, per week	35.0
Each shower	.5
Each tub bath	.2
Normal respiration and skin evaporation per person per 24 hour day	2.9

Vapor Barrier

1.7.2

Vapor barriers, such as polyethylene, asphalt, glossy asphalt coated paper, laminated moisture-proof paper, foil-backed sheet rock, batts, or blankets should be used and applied near the warm surface between the inside finish and the insulation of all outside walls, outside ceilings, and the floors.

The measurement of water-vapor transmission of a barrier is expressed in perms. A perm, the unit of permeance, equals one grain (7000 grains = 1 pound) of moisture per square foot per hour per inch of mercury vapor pressure difference. For a vapor barrier to be effective it should be one perm or less. The part of the wall on the ouside of the barrier should have a permeance of at least 5 perms so that moisture vapor can escape easily to the outdoors.

When installing a vapor barrier, the number of joints should be held at a minimum. Every precaution must be taken so that the vapor barrier is not damaged during or after installation. If it is, it must be repaired completely and perfectly. Vapor pressure sealing tape is available to seal joints in the barrier and breaks around pipe and wiring outlet boxes.

When the outside wall is insulated but has no vapor barrier, or if the vapor barrier is installed on the cold side of the insulation, vapor penetrates the insulation and condenses inside the wall cavity causing rotting and decay. The condensation also wets the insulation, making it ineffective.

If polyethylene plastic film is used for vapor proofing walls, ceilings, or floors, it should have a minimum thickness of 0.002 inch. If the joints are not sealed, they should be lapped at least 2 inches on a stud or joist to obtain a pressure proof seal. Foil type vapor barriers come attached to some insulation blankets and batts and must be continuous for all wall sections.

When blown insulation is to be used in new work, continuous vapor barriers should be applied to the underside of ceiling joists where specified, and to the inside of wall studs. The barrier should be brought up tight against electrical outlets, registers, door and window frames, and other similar openings.

In an existing house where it is impossible to install a mechanical vapor barrier, paints may be used on the inside room surfaces. The following have proven effective: aluminum paint with spar varnish as a vehicle, some emulsion paints specifically designed for the purpose, primer sealer plus enamel, and rubber-resin lacquer types. Two or three coats are necessary.

A second vapor barrier should never be installed near the outside of the walls since it will result in moisture being trapped between the two vapor barriers. A porous wind-barrier type of paper should be used on the outside areas to provide an exit for entrapped moisture.

The vapor barrier for slab floors should be placed under the concrete. The water vaporpermeance of the material should not exceed 0.5 perm. For polyethylene a thickness of 0.004 inch should be used when placed on sand or tamped earth under concrete slab and 0.006 inch over gravel or crushed stone.

The ground surface of a crawl space should be graded and covered with a long life vapor barrier of either 55-pound asphalt-saturated felt roll roofing or 0.004 inch polyethylene plastic film. The roofing paper should be lapped 6 inches, and the plastic film joints should be lapped 2 inches or more, but neither should be sealed. The water vapor permeance of the ground cover material should not be more than 1 perm.

ENERGY CONSERVATION BULLETIN 1.10.1
Environmental Considerations

Intermountain Rural Electric Association 303 794 1535
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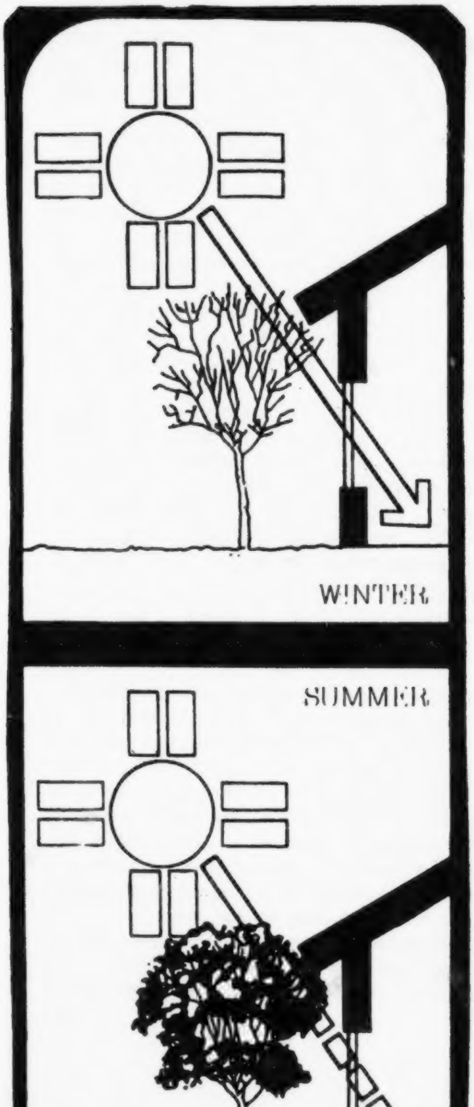
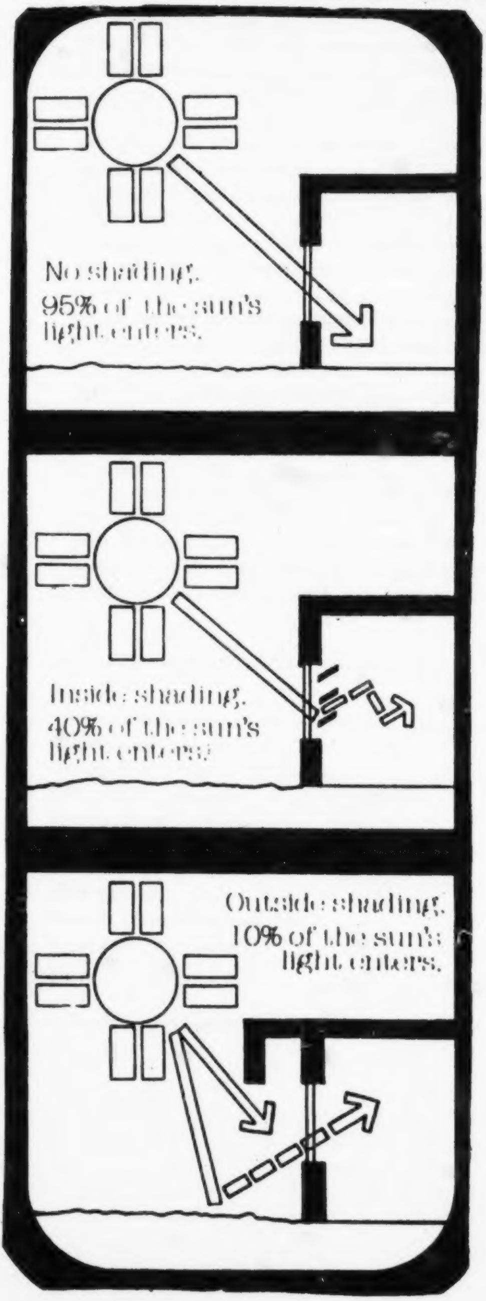
Trees and shrubs around a house can help to protect it from the wind, which causes drafts and loss of heat. A single row windbreak is effective, but a staggered double row is better. Deciduous trees (those which lose their leaves in winter) near the house will allow the sun to help warm the house in the winter.


WINTER
SUMMER

A good way to keep your house cool in the summer is to shade it from the outside. The South side is where the most heat comes through — if you can shade here, it'll show up right way in a smaller air conditioning bill and a cooler home. Any way that stops the sun before it gets in through the glass is seven times as good at keeping you


No shading.
95% of the sun's light enters.
Inside shading.
40% of the sun's light enters.
Outside shading.
10% of the sun's light enters.

cool as blinds and curtains on the inside. So trees and vines that shade in the summer and lose their leaves for the winter are what you want — they'll let the sun back in for the winter months. If you can't shade your house with trees, concentrate on keeping the sun out of your windows — awnings or even permenent sunshades will do the job (but only on the **south** side; they won't work on the east and west).

Roof overhangs shade houses from the summer sun without shading the winter sun when designed properly. This is due to the higher maximum altitude of the summer sun as compared to the winter sun.

Thick evergreens on the north and northwest side shield the house from the prevailing winter winds and they can aid cooling in summer. Forest service researchers note that transpiration from a single tree may produce 600,000 Btu/day of cooling.

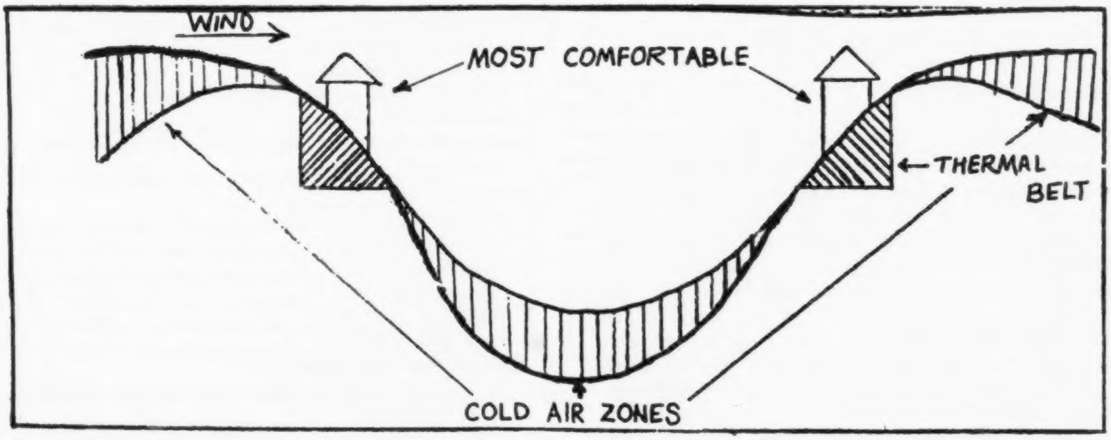
In most parts of the country air conditioning is not necessary. Insulation, shade and natural ventilation sometimes supplemented by an attic exhaust fan are quite adequate if properly used. If shade trees are not yet large enough to provide adequate shading, various commercial products such as adjustable louvers and tinted plastic are available to cut down heat gain.

The placement of houses in hilly or mountainous regions is an important environmental consideration. The diagram illustrates positions which will have the greatest thermal comfort.

The valley is coldest at night and has earliest frosts. Also, it is often the hottest on hot summer days because sunlight is reflected off the hillside. Strong winter winds may also blow through the center of the valley and be unfelt on the hills. But be sure your site has adequate direct sunlight.

Windows should be avoided or kept to a minimum on the north side as their main effect is heat loss in winter.

Large paved areas near the house can reflect heat into the house and cause excess heating in summer.



ENERGY CONSERVATION BULLETIN 2.1.1
Electric Heating Systems

Intermountain Rural Electric Association 303 794 1535
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ELECTRICITY is energy in a refined form which is ideally suited to space heating because it is simple to distribute and control. For many applications, the compactness, simplicity, responsiveness, accuracy of control, safety, and cleanliness of electric heating may outweigh other considerations in choice of heating method. The adaptability of electric energy for distribution, conversion, and regulation within a structure, as compared with fossil-type forms of energy, provides a most effective and efficient means of utilization of energy for space heating. Complete electric heating systems are widely used in residences, schools, and in many commercial and industrial establishments. Electric space heating is often used where minimum initial cost is the dominating factor. Electric heating systems may be used to supplement solar heating systems.

DECENTRALIZED SYSTEMS

Decentralized systems utilize units applied to individual rooms, and while usually only one type predominates per room, types may be mixed if occasion arises. Often the individual rooms are combined into a system or zone. Examples of equipment so utilized are electric baseboard heaters, convectors, sill-line heaters, unit heaters, and unit ventilators.

CENTRALIZED SYSTEMS

Central Hot Water Systems

Heating systems of hot water type using radiators or convectors, may be operated using an electric hot water boiler containing immersion elements. Such boilers are extremely compact and may be designed for wall mounting. The size of a 20 kw boiler is about 1.5 cu. ft. Multiple elements of appropriate kw capacity (from 2 to 5 kw each) make up the total heating capacity required. The elements are usually arranged to be energized or de-energized in sequence to avoid large voltage disturbances. The elements should be interlocked to prevent energizing when the circulating pump is not operating. Some makes of boilers are particularly adaptable to multiple zoning by having control systems which energize the number of elements that match the heating needs of the zones calling for heat.

For off-peak operation, a water heating tank of large storage capacity may be employed. The system may be designed for a water temperature of 250 to 275 F at pressures up to 75 psig, with suitable piping systems for this pressure. An automatic valve may provide 140 to 160 F water at the pump by mixing hot water from the tank with cooler water from the return main. Another method employs the flash principle, withdrawing water at high storage temperature into a low-pressure separating chamber where steam is obtained as a result of the pressure reduction; however, power for pumping is substantially greater with this steam-accumulator method.

Central Warm Air Systems

Central blower and air duct systems are adaptable when summer cooling is planned or when circulation, filtering, humidifying, or dehumidifying of the air is desired. Such systems furnish a convenient means for positive intake of fresh air.

Compact electric heating units are sometimes installed in main supply or branch ducts of central-fan steam and water systems to provide the final temperatures and relative humidities required for comfort or process air conditioning. Electric heaters installed for use primarily in the heating cycle can also be utilized for reheat in the cooling cycle.

Individual room control is obtained by using electric duct or air outlet heaters.

Electric furnaces, consisting of resistance heating coils and a blower housed in an insulated cabinet, are available in sizes ranging from 5 kw to 60 kw for use with residential ducted warm air systems. Electric furnaces are compact, require minimum wiring and no fuel connections or fuel piping. While not adaptable to individual room control, a separate electric furnace may be used for each of two or more larger zones.

Principal Types of Electric Space Heating Systems

Decentralized Systems
A. Natural Convection Units
  1. Floor drop-in heaters
  2. Wall insert and surface-mounted heaters
  3. Baseboard convectors
  4. Hydronic baseboard convectors with immersion elements
B. Forced Air Units
  1. Unit ventilators
  2. Unit heaters
  3. Wall insert heaters
  4. Baseboard heaters
  5. Wall insert heaters
  6. Floor drop-in heaters
C. Radiant Units (high intensity)
  1. Radiant wall, insert or surface mounted; open ribbon or wire element
  2. Metal-sheathed element with focusing reflector
  3. Quartz tube element with focusing reflector
  4. Quartz lamp with focusing reflector
  5. Heat lamps
  6. Valance heaters
D. Radiant Panel-Type Systems (low intensity)
  1. Radiant ceiling with embedded conductors
  2. Pre-fabricated panels
  3. Radiant floor with embedded conductors
  4. Radiant-convector panel heaters

Centralized Systems
A. Heated Water Systems
  1. Electric boiler
  2. Electric boiler, with hydronic off-peak storage

   3. Heat pumps
   4. Integrated heat recovery systems
B. Steam Systems
   1. Electric boiler, immersion element or electrode type
C. Heated Air systems
   1. Duct heaters
   2. Electric furnaces
   3. Heat pumps
   4. Integrated heat recovery systems
   5. Unit ventilators
   6. Self-contained heating and cooling units

The above units have commercial-industrial as well as residential applications. The more common residential decentralized units include the radiant panel-type systems (low intensity) and the natural convection units, particularly the baseboard convectors and the hydronic baseboard convectors with immersion elements.

Intermountain Rural Electrical Association generally recommends these separately controlled (decentralized) heating systems. They are typically cheaper to operate and less of a burden on the overall electrical systems than the centralized units.

Since decentralized units have individual thermostats in each room, energy can be conserved by lowering or shutting them of in areas where heat isn't needed. Decentralized units are also very compatible with load control devices.

FURTHER CONSIDERATIONS

Any electric heating unit considered for purchase and installation should bear the Underwriters Laboratories Listing Mark, giving the purchaser assurance that it has been tested, and is listed by Underwriters Laboratories (or has the CSA mark, in Canada).

Separately-controlled units [Decentralized System]

Baseboard radiation. These units are similar in outward appearance to the baseboard radiation commonly used with gas-and oil-fired hot-water heating systems. As they provide heat mainly by convection, they may cause problems of dirt — streaking on the walls. They are, on the whole, a very satisfactory means for heating a room by electricity.

Buit-in wall heaters supply heat mainly by radiation. Some models are equipped with small fans which increase slightly the amount of heat given off by convection. The fan produces a slight amount of noise.

Resistance wires embedded in the ceiling in ceiling panels, and ceiling heaters controlled by wall-mounted thermostats are sometimes used for electric heating. The embedded wires have the disadvantage that there is a considerable lag between the time heat is called for and the time when a room becomes noticeably warmer. Heat from the ceiling is supplied mainly by radiation. Portable space heaters are designed to give rapid, deep-room penetration. Portable electric heaters can be moved from one spot to another. Various models feature: fixed or portable heavy-duty thermostatic controls with a range of 55° to 100° F; automatic current cutoff if heater is tipped forward or the front is obstructed: and dual-wall construction to keep the cabinet cool and safe to the touch. This type heater should be used only for temporary or emergency applications.

Central systems

A central heating system using electricty functions in much the same way as a system using oil, gas, or coal as a fuel. The heat is produced at one location and distributed throughout a home.

In a forced-air electric furnace, air is heated as a blower forces it past heated resistance elements and into a system of ducts. Such a system heats rooms by convection and offers air filtering and relatively easy adaptation to air conditioning as two important advantages. Electric forced-warm-air heat does, however, present most of the disadvantages related to the need for space for the furnace and existence of blower noise that are characteristic of gas or oil forced-air heating.

Electric hydronic (hot water) systems employ conventional baseboard radiation by which heat is transferred from the radiators, by both radiation and convection. Electric hydronic systems are characterized by a very small boiler, and they offer the decided advantage that they do not require any provision for entrance of some cold outdoor air into the house (or furnace room), as is necessary for safe combustion of gas, oil, or coal fuels.

A heat pump can function as a heating OR cooling source. As the name implies it produces heat by using the compressor as a pump. Electricity is not converted directly into heat as occurs with other kinds of electric heating. In the cold seasons, a heat pump extracts heat from the cold outside air, and carries it into the house. (Actually outdoor air, though cool, contains recoverable heat). Instead of supplying about 3400 Btu for every kilowatt-hour expended (the usual Btu per kwhr conversion ratio), a heat pump will supply 1¼ to 2 times that amount, depending upon the temperature outdoors. Thus it supplies a means of heating with electricty at about two thirds the usual cost (neglecting investment costs, depreciation, and maintenance of the equipment). In the warmer months, the flow of the refrigerant in the machine is reversed — the heat pump then functions to remove heat from the building and thus functions as an air conditioner.

There are several important points to consider with regard to use of a heat pump:

1) The machine and its installations will likely be expensive.

2) In the wintertime, efficiency falls off to a low figure as outdoor temperatures fall. As temperatures drop well below about 40°F outdoor, the heat pump needs more and more support and regular resistance-type heaters — which are much more costly to run — are turned on, automatically as a rule.

ENERGY CONSERVATION BULLETIN 2.2.1

Electric Heating : Radiant

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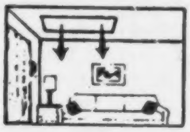
Comfort, as defined by ASHRAE Standard 55-74, is "that condition of mind which expresses satisfaction with the thermal environment." The person is not aware that he is being heated or cooled. Recent investigations have broadened our knowledge regarding the human body and its response to the surrounding environment. The mean radiant temperature (MRT) has a strong influence on the feeling of comfort. When the surface temperature of the outside walls, particularly those with large amounts of glass, begins to deviate excessively from the ambient air temperature of the space, it becomes increasingly difficult for convective systems to counteract the discomfort resulting from cold or hot walls. Heating and cooling panels neutralize these deficiencies and minimize excessive radiation losses from the body.

Radiant
Ceiling Panels



Panel heating systems function on the basis of providing a comfortable environment by means of controlling surface temperatures and minimizing excessive air motion within the space.

Radiant heat comes from thread-thin wire embedded in panels, which are flush with or suspended from ceiling.

- Whole house or supplemental heating.
- Especially good over large glass areas.
- Individual room control.
- Easily installed in new or existing home.

The ceiling is the room surface most often used for location of the radiant panel. It sees all other surfaces and objects in the room. It is not subject to unpredictable coverings, as are floors. Higher surface temperatures can be used. It is of smaller mass and therefore has quicker response to load changes. Radiant cooling can be incorporated, and, in the case of the metal ceiling system, the piping is accessible if in need of service.

Radiant panels are unique in that, unlike most heat transfer equipment where performance can be measured in specific terms, the performance of the radiant panel is related directly to the structure in which it is located, and an understanding and evaluation of this interrelationship is desirable.

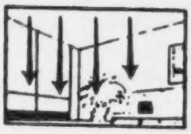
SIZES AND INSTALLATION

Easily installed, either flush with ceiling or protruding slightly, in all types of new or remodeled construction. Panels are usually rectangular. Most are pre-wired and assembled by the manufacturers.

SUGGESTED APPLICATION

Whole-building and supplemental heating. Panels are especially useful over large glass areas. Used in bathrooms, kitchens, family, and recreation rooms as well as problem heating areas.

Radiant
Cable Heat



Gentle, even heat radiates from cable embedded in ceilings (or floors).

- Completely out-of-sight.
- Individual room control.
- Silent operation.
- No maintenance.

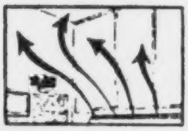
Ceiling cable is hidden, so it puts no limits on furniture arrangement. It beams soft heat into the room over a wide area, so people are usually unaware of the heat source. And it can move, stretch, or bend with any movement of the ceiling or house.

Ceiling cable, though least expensive to install, demands heavier ceiling insulation than wall panels and baseboard units. Otherwise, you'll lose too much heat to the attic, and operating costs will rise.

ENERGY CONSERVATION BULLETIN 2.3.1

Electric Heating : Resistance Units

Intermountain Rural Electric Association 303 794-1535
2100 West Littleton Blvd Littleton Colo 80160



Baseboard

A metal casing, in the same configurations as conventional baseboard along walls, contains one or more heating elements placed horizontally. Heating elements may be finned sheathed, cast grid, ceramic extended surface, or electrically conductive coatings on glass or other material. The vertical dimension is usually less than 9 in., and projection from wall surface is less than 3.5 in. Units are available from 1 to 12 ft. long with ratings from 100 to 400 watts per ft of length and are designed to be fitted together to make up any desired continous length or rating. Sill heaters are available with ratings up to 1000 watts per ft. Electric hydronic baseboard heaters containing immersion heating elements and an antifreeze solution are available in ratings from 300 to 2000 watts. Air circulates from a slit at the bottom, over the heating element and out into the room. There is no noise from moving air or equipment, blowers, or parts.

INSTALLATION

They should be placed at floor level of outside wall. Heat circulation is not distributed by furniture placement.

Baseboard units are usually self-contained. Installation is fast and easy since most types are pre-wired and assembled at the factory.

This electric resistance heating is strung together like continous toasters along outside walls. They usually take 240-volt current.

- •Compatible with existing baseboard.
- •Easily and quickly installed in new or existing homes.
- •Individual room control
- •This system produces no fumes, gas or smoke, is quiet and requires very little maintenance.

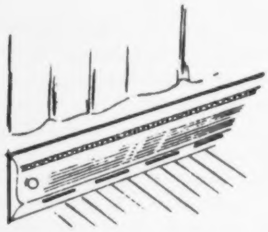
Baseboard units help keep wiring out of the walls, thus reduce high wiring costs. Most baseboards have plenty of room for lighting and appliance circuits. Receptables, available in most baseboard lines, can be fitted right into the ends of the units.

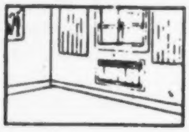
High-temperature baseboards offer the most efficient electric heat in colder climates. They put the heat where it's needed most — around the perimeter of the house. Low-temperature baseboards offer "softer," less concentrated heat.

Baseboard units save labor because they are surfacemounted after the wall is finished. All you do before finishing the wall is to install the 240-volt leads (some low-temperature units take 110).

Baseboard comes in sections that vary in length from 2' to 12' and in height from 6" to 10". It has corner pieces and can be painted.

NOTE: Drapes should be shortened, so as not to come in contact with heaters.





Wall Heeter [picture]

If it doesn't interfere with window treatment, unit should be placed on outside wall. Due to high temperature, unit should not be located close to inside doors or furniture.

- •Individual room control.
- •May be installed where heat is required only occasionally.

In many wall and floor insert heaters, a small fan circulates room air over the resistance heating elements and back into the room. They are all regulated by thermostatic controls (either built-in or wall-mounted). Installation of a complete unit into a roughed-in box takes only a few seconds since the reflector heating elements and controls may be mounted to the grille front.

Wall units are recessed into the wall (and sometimes the ceiling) so that only the front of the units projects into the room. So it is necessary to build in frame boxes, like rough window openings, at the framing stage of construction. This means extra labor and higher installation costs.

You can keep costs down by using wall panels where you want to concentrate heat (ie, in bathrooms) and baseboard units in other rooms.

ENERGY CONSERVATION BULLETIN 2.4.1

Hot Water Heaters

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

Buying A Hot Water Heater

When purchasing a water heater, match its size to the needs of your family. Oversized water heaters use more energy than necessary.

Cost of Operation

A. Approximately 17% of the total-electric bill of an all-electric home goes to water heating.

B. About 47% of the total-electric bill for the all-electric home without electric heat is for the electric water heater.

Energy-efficient water heaters may cost a little more initially, but reduced operating costs over a period of time can more than make up for the higher outlay.

•Buy a water heater with thick insulation on the shell. While the initial cost may be more than one without this conservation feature, the savings in energy costs over the years will more than repay you.

•Add insulation around the water heater you now have if it's inadequately insulated, but be sure not to block off needed air vents. That would create a safety hazard, especially with oil and gas water heaters.

*Heating of water continues even if hot water is not being used.

Standby heat loss varies on water heaters depending on the location, the size of the heater and the amount of insulation used.

Average standby losses vary from 4 watts per sq. ft. to 7.9 watts per sq. ft., depending on the thickness of insulation used.

Square feet of tank area averages about —
26 sq. ft. for a 50-gallon heater
30 sq. ft. for a 66-gallon heater
36 sq. ft. for a 80-gallon heater

INSTALLING A HOT WATER HEATER

*Place the water heater as close as possible to where hot water is used. Long runs of pipe cool hot water, thus increasing operating costs.

*If you do have long pipe runs, insulate the pipes to decrease heat loss. This also conserves water which may be wasted by letting it run until it gets hot.

OPERATING A HOT WATER HEATER

- Check the temperature on your water heater. Most water heaters are set for 140°F. or higher, but you may not need water that hot unless you have a dishwasher. A setting of 120 degrees can provide adequate hot water for most families.

If you are uncertain about the tank water temperature, draw some water from the heater through the faucet near the bottom and test it with a thermometer.

In the average home between 35% and 50% of total water use is hot water.

ESTIMATED WATER USE

A. Tub bath	10-15 gal.
B. Shower (under 5 min. duration)	8-12 gal.
C. Automatic washer	25-30 gal.
D. Automatic dishwasher	11-16 gal.
E. Hand wash dishes (each time)	9-14 gal.
F. Shampoo	5-7 gal.
G. Cleaning	3-8 gal.
H. Food preparation	5 gal.

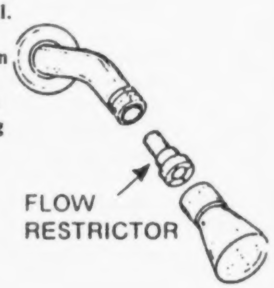
AVERAGE HOT WATER USED PER DAY

2 adults 1 child — 60 gal.
2 adults 2 children — 70 gal.
2 adults — 3 children — 80 gal.

A leaking hot water faucet should never be disregarded. Little drops of water cost money. Here are several typical examples of how much hot water and electricity can "go down the drain" through leaky faucets!

DROPS PER MINUTE	GALLONS PER MONTH	KWH PER MONTH
60	192	48
90	310	78
120	429	107

To reduce consumption a "flow restrictor" to limit the shower flow may be helpful. This little device can be installed in minutes, and can cut the shower flow from 6 gpm to 3 gpm, thus saving a lot of hot water and reducing energy requirements for heating water.



*Approximately three times a year, drain a pail or two of water from the faucet at the bottom of your hot water tank to get rid of sediment and mineral deposits. This will lengthen the life of the unit and assure a higher operating efficiency.

*When you go away for a period of time — for a weekend or longer, vacation, etc., shut the electricity off to the hot water heater.

ENERGY CONSERVATION BULLETIN 2.5.1
Thermostatic Controls

Intermountain Rural Electric Association 303 794 1535
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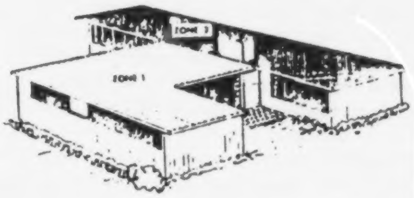
Automatic controls are designed to run heating and cooling systems automatically so that they function only when heating or cooling is needed. This helps keep the house at an even temperature, which adds to the comfort of the occupants and reduces the cost of operating the system.

The heart of the control system is the thermostat, essentially a temperature-sensitive switch that turns the heating system (or cooling system) on and off. Some thermostats are designed so that various stages or parts of the heating system can be turned on or off so that the heat input is "modulated" to match the heat loss of the house. Many thermostats are equipped with small heating elements called anticipators. The anticipator raises the temperature within the thermostat case, giving it a false reading and causing it to turn the system off before the room reaches the desired temperature. The residual heat in the system will then bring the temperature up to the desired point. If there is not sufficient residual heat, the thermostat will sense the deficiency and turn the system on again. In this way the desired temperature is reached in small steps so that the house is not overheated, with a resultant waste of fuel and occupant discomfort.

In many instances, one thermostat is used to control the temperature in several rooms or the whole house. Actually, it can sense the temperature only in the room where it is located. For this reason it is important that the thermostat be located either where the temperature is representative of the whole house or where temperature control is most important. Locate the thermostat at a height of 2½ to 4 feet above the floor. Avoid locations on ouside walls, near outside doors, or in bedrooms where windows may be left open. Likewise, do not place it near heat outlets, behind doors, on walls that receive heat from the sun or fireplace, or on walls that house heating pipes ducts, or chimneys. Avoid locations that may interfere with furniture placement. Lamps, TV sets, or radios under a thermostat will give it false readings and result in poor control of the heating system.

In some cases, it may be desirable to divide the house into 2 or more zones for heating (or cooling) control. With non-central systems (such as electric resistance baseboard or ceiling cable), zone control is relatively easy to achieve.



With ducted or piped systems, the distribution lines must be specifically designed for this purpose. Zoning is used to help maintain the same temperature in various parts or levels of the house. Zoning should be considered for multi-level or large houses, or when there are unusual sun or wind exposures.

The division into zones should be based upon exposure or occupancy; the most common division is usually found to be: (1) the living section such as living room, dining room, den; (2) the sleeping section; (3) the service section such as kitchen, pantry and (4) recreational areas.

The thermostat should be set at the point at which the occupants are most comfortable and left at that setting except for special circumstances. These special times occur at very cold outside temperatures, when heating is almost continuous. At that time, thermostats equipped with anticipators may have a tendency to "droop" and maintain a temperature a few degrees below the setting. In these cases, the thermostat setting will have to be adjusted. A setting above the desired temperature will not make the temperature rise any faster nor will a low setting cause the house to cool any faster. The speed with which the temperature in a house will respond to a change in the thermostat setting will depend on the type of heating system and the construction of the house.

If you leave home for a few days turning your thermostat down can result in savings. However, never turn your thermostat completely off. A sudden cold snap could cause your pipes to freeze and burst causing substantial damage to your home.

Maintenance. A properly functioning thermostat will keep your home at comfortable temperatures. However, a number of things can affect its performance. The most common problem causing poor thermostat operation is dust covering the sensing element or contact points. A layer of dust will reduce the speed with which the thermostat feels a change in temperature, which allows the house to get too cold before the heating system comes on and lets it get too hot before it shuts the system off. To correct this problem, remove the cover from the thermostat and carefully vacuum the mechanisms. If the material is caked on, a service call will be required.

Another occasional problem is that the thermostat loses its calibration. For example: The thermostat is set on 68° and the room temperature is more than 2° or 3° above or below this (72 or 64°). The easiest solution is to set the thermostat at whatever position it takes to maintain the desired room temperature and mark this point. Some models have a calibration adjusting screw on the sensing coil mounting. Others require repositioning the thermostat on the wall so that it is level. To recalibrate a thermostat, use a good quality thermometer to measure the temperature near the themostat. Then move the sensing element so that the contacts just open when the pointer is set at the room temperature. Some readjustment may be needed if an accuracy of 1° or less is desired.

A third way that the thermostat can fail is by a break in the anticipator. This may cause some overheating of the room before the furnace shuts off. If the variation between "on" and "off" is not too great, you can set the thermostat to a lower setting. Repair of the anticipator requires a good serviceman or replacement of the thermostat.

Older thermostats may have problems with corrosion of the contact points. They can be cleaned with a piece of bond paper or crocus cloth. (Be sure to shut off the power to the thermostat before you start to work.)

ENERGY CONSERVATION BULLETIN 2.6.1

Fireplaces

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Free Standing Fireplaces and Wood Stoves

Under $700.

Light weight (can be installed on existing floors).

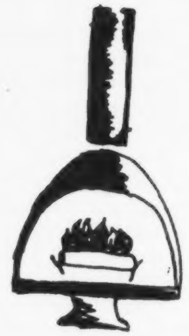
Wood Stoves have high efficiency. Free Standing Fireplaces have poor efficiency.

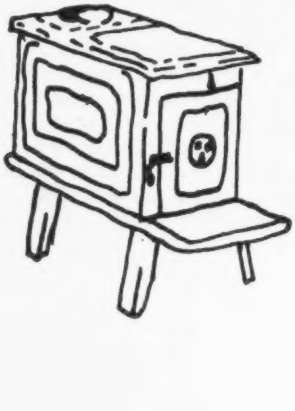
Pre-engineered to function properly.

Can be installed by most do-it-yourselfers.

May have shorter life than masonry fireplace (thin metal units may burn out.)

Must be placed a certain distance from walls and other combustible material.





Pre-Built Installed Fireplaces

Between $500-$1500.

Medium weight (can usually be installed on exisiting floors).

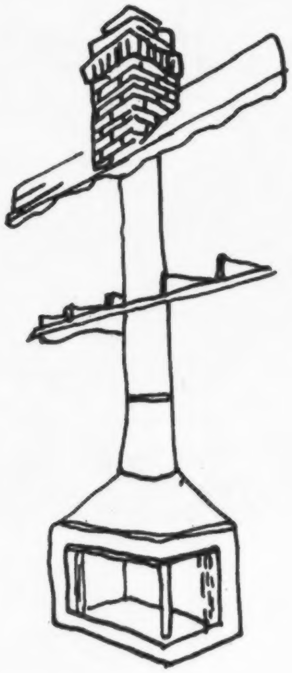
Slightly higher efficiency than solid masonry type.

Pre-engineered to function properly.

Can be installed by most do-it-yourselfers.

Glass door fire screens should be used.

Adds to home value.



2.6.2

Masonry Fireplaces

Between $100-$3000

Very heavy (needs separate foundation). Low efficiency — 10% or less — (higher efficiences available with heat circulating metal form type).

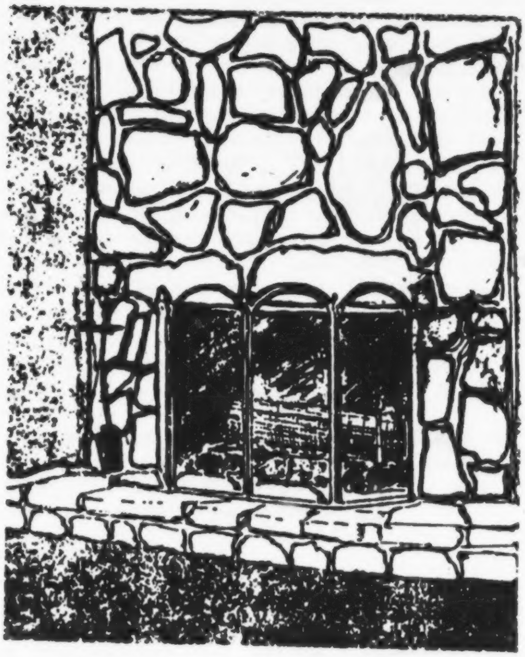
Should be built by qualified mason (one mistake can be very costly).

Should have outside draft and combustion air supply.

Glass door fire screens should be used.

Has traditional appeal and charm.

Adds more to home value than other units.



Mobile Home Fireplace

Between $350-$500.

Similar to pre-built installed fireplace but with these differences:

Air for the fireplace must be brought in from outside.

No dampers are permitted on the combustion air inlet or flue gas outlet.

There must be a door to close off the fireplace.

The door, usually glass, should be kept closed except when adding fuel.

Chimney must have a spark arrester.

Wood, coal, or charcoal may be burned.

Unit must carry seal of Underwriters Laboratories (UL). If it doesn't, it likely does not meet the above standards and shouldn't be used in your mobile home.

Your local library has books containing dimensional data and technical information on building and installing fireplaces.

ENERGY CONSERVATION BULLETIN 2.7.1
Heat Pumps

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Despite its name, a heat pump is designed to provide summer cooling as well as winter heating. In other words, a heat pump replaces both furnace and central air-conditioning equipment with a single heating-cooling system.

Most heat pumps are compact units that, except for indoor components, are installed outside the home. In size and appearance they look like the outdoor unit of central air conditioner.

In summer, a heat pump operates as a standard, electrically driven, air conditioner, collecting heat from the air in your home and expelling it outside.

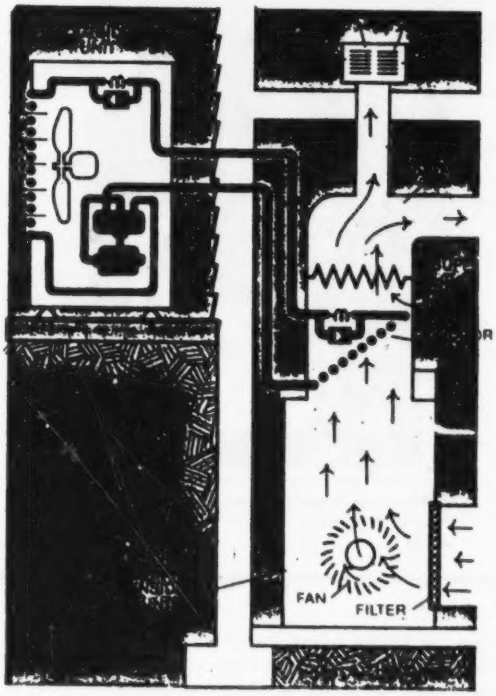
In winter, the process is reversed so that the heat pump collects heat from outdoor air to warm the air inside your home.

The heat pump can do this because heat exists in all air. Even cold winter air (down to minus 460°F.) contains heat. For the colder days, most heat pump installations have a booster electrical resistance heater that automatically switches on to supplement the heat brought in from outside.

Heat pumps generally don't function efficiently once the temperature drops below freezing. So if very cold days are the norm where you live, a heat pump may not be the most cost-effective option. The industry is presently addressing itself to this problem and alternative designs which, for example, extract warmth from solar collectors or from ground water may increase the temperature range at which heat pumps operate.

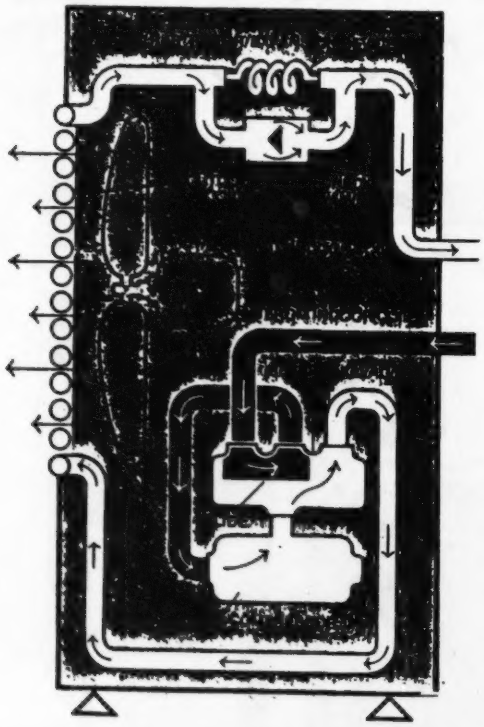
How does the heat pump save energy? It's the heating cycle that accounts for the significant energy savings that are produced by heat pumps. Unlike a furnace that turns fuel or electricity into heat, the heat pump collects heat that already exists in the outdoor air by means of its refrigeration cycle. This means that the heat pump can supply from one-and-ahalf to two-and-a-half times more heat than the energy it uses. Engineers refer to this advantage of the heat pump as the efficiency or Seasonal Performance Factor (SPF). The higher the SPF, the more efficient the unit.

In a typical heat pump installation in a home, the outdoor unit contains the outside coil, compressor and reversing valve. Refrigerant travels through pipe or tubing to the inside coil located in the path of air circulated by inside fan. The supplemental electric heater above the inside coil is activated when the heat loss of the building exceeds the heat pump output on colder days.

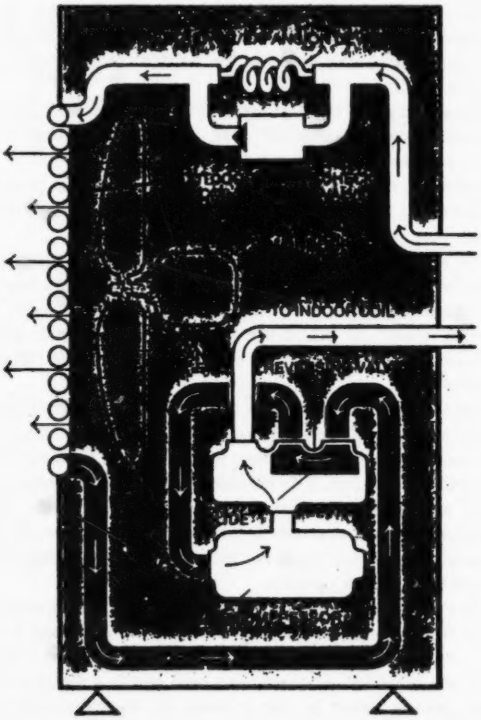


These schematic drawings show the inner workings of a heat pump.

Cooling cycle. Refrigerant passes through inside coil, evaporating from a liquid to a vapor. As the liquid evaporates, it absorbs heat, cooling the air around the coil. An indoor fan pushes this cooled air through ducts inside the house. Meanwhile, the vaporized refrigerant, laden with heat, passes through a compressor which compresses the vapor, raising its temperature and pressure. The reversing valve directs the flow of hot, high pressure vapor liquid to the outside coil, the heat released during condensation is fanned into the outside air, and the cycle begins again.



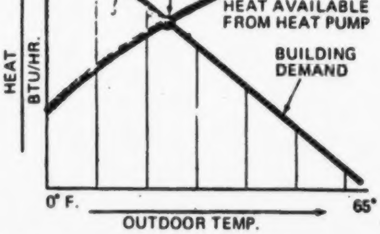
Heating Cycle. Note that the valve inside the reversing mechanism has shifted, causing the refrigerant flow to reverse. Liquid refrigerant now flows to the outside coil, picking up heat as it evaporates into a low pressure vapor. The vapor travels through the compressor where it is compressed into a hot, high pressure vapor, then is directed by the reversing valve to the indoor coil. The vapor turns to liquid as it passes through the indoor coil, releasing heat that is pushed through the ducts inside the house by the indoor fan.



If you are buying a heat pump for the first time, you should be aware of some of its features that are somewhat different from the conventional central system.

1. The Balance Point

   The heat pump compressor itself will provide all the heat your home needs until the outdoor temperature drops down to what is known as the "balance point." This is usually about 30 degrees. Below this point auxiliary resistance heat will automatically switch on, supplementing the heat from the compressor and maintaining the comfort level in your home.



As outdoor temperature rises, heat-pump output [line A] increases, while building's heat requirements [line B] decreases. Below the balance-point temperature, the heat pump cannot meet the building's heat demand, and a source of supplemental heat must be turned on.

2. Lower Supply Air Temperature
   During the heating season, the heat pump circulates a larger quantity of lower temperature air than you may have been accustomed to in a home with a conventional central furnace. But don't be concerned about this lower temperature air coming from your registers. Your heat pump will provide pleasant heating.
3. The Defrost Cycle
   During the heating season, your outdoor coil will occasionally collect frost and ice. The rate of collection depends upon the outdoor temperature and relative humidity. In order to maintain proper air flow over the coil, the unit will automatically "defrost" itself. Most of the time you will never realize this is taking place. But on rare occasions the unit will appear to smoke or steam. This is a normal operating condition, so don't let it alarm you.

Also consider:

•Initial cost. Get two or three contractors to estimate the installation cost of a heat pump for your home versus the cost of an alternative heating-cooling system.

On the average, heat pumps have a higher initial cost than other heating-cooling systems. The higher cost is a reflection of the durability that must be built into the heat pump for year-round operation in hot and cold weather, and of the heat pump's sophisticated control mechanisms.

Despite the higher installation cost, the heat pump's efficiency can produce significant savings on monthly heating costs. This makes it possible for the cost of owning and operating a heat pump to be comparable to or lower than alternative heating-cooling systems, depending on the cost of energy and the severity of the winter.

•Payback. Figure out how many years it will take for your heat pump to pay back its higher initial cost with lower annual operating costs. You can do this by dividing the estimated annual operating savings into the extra cost you'd pay for a heat pump installation.

2.7.3

Heat Pump Rating

1. Energy efficiency Ratio (EER)
   The EER is a measure of their cooling capacity — in BTU's per hour — divided by the electricity they consume — measured in watts.
   As a general rule, 7.0 is good; anything rated at 8.0 or higher is excellent.
   A unit with an EER of 9 uses one-third less energy than one with EER-6.

2. Coefficient of Performance (COP)
   The efficiency of heat pumps for heating is measured by their Coefficient of Performance (COP), an industry yardstick. Electric resistance heating has an efficiency of 100 percent, or a COP of 1.00.
   This ratio is calculated by dividing the total heating capacity provided by the refrigeration system including circulating fan heat but excluding supplementary resistance heat, (Btuh) by the total electrical input (watts) x 3.412.

$$\text{COP} = \frac{\text{BTU per hour (output)}}{\text{Watts per hour (input) x 3.412}}$$

3. Seasonal Peformance Factor (SPF)

   During the heating season, the heat pump's Coefficient of Performance increases on mild days and decreases on cold days. The average COP for the heating season (the Seasonal Performance Factor)therefore is higher in a mild climate than in a region where winters are severe.

ENERGY CONSERVATION BULLETIN 2.8.1
Air Conditioning

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I — Refrigeration Type Air Conditioners

A simple explanation will clarify the operation of air conditioners.

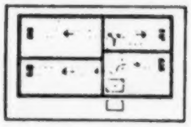
Liquids absorb heat as they vaporize to gas and lose it again when they return to liquid state. If the heat is absorbed inside a house and lost outside, the house is cooled. Refrigerants do this very efficiently by vaporizing (boiling) at low temperatures.

In an air conditioner, warm air from the house is passed over coils of cold liquid refrigerant and returned to the house by a fan. In absorbing heat from this air, the refrigerant becomes gas. A compressor "squeezes" the warm gas, concentrating its heat, and it enters condenser coils. Another fan blows outside air over these coils and cools the gas back into liquid. The cycle then continues.

As the inside air is cooled, it must give up moisture — it is dehumidified.

When you buy a cooling system, compare the Energy Efficiency Ratio (EER) of various brands. EER indicates the number of cooling BTU's delivered by a cooling system for each watt of electrical input. The higher the EER, the less energy required for the same amount of cooling. The EER will be a number ranging from 4.7 to 12.2. You can figure the EER of a unit you already own by dividing its capacity in BTU's by its wattage rating. An 18,000 BTU air conditioner rated at 3000 watts would have an EER of 6, which is only fair. If you purchase the unit with the higher EER, even though it costs more initially, you will probably save more in electricity costs in the long run. Buy the cooling system with the smallest capacity that will do the job.

Buy a unit with the capacity that matches your needs. An over-sized unit not only will cost more, but will operate inefficiently. If you can't match your cooling needs to a unit's capacity, go with a slightly smaller unit.

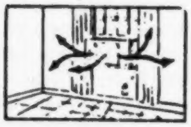


Central System

A duct system distributes cool air to every room from a central unit.

- More effective than window or thru-the-wall unit.
- Dehumidification.
- Air filtered.
- Heating system can be added, using existing ductwork.
- Increases value of home.

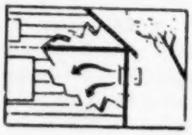
Consider central air conditioning if you consistently operate a number of room units. Installing central air conditioning requires a dependable contractor. A solid reputation counts.



Window Unit

May be placed in any window large enough for the unit and where there is or can be adequate wiring. Unit should be shielded from direct sunlight.

- Inexpensively installed in any home.
- De humidification
- Air filtered.



Thru-The-Wall Unit

Should be placed as high above floor as practical on outside wall that is shielded from direct sunlight.

- Dehumidification.
- Air filtered.
- May be installed in existing home.

- Turn off your window air-conditioners when you leave a room for several hours. You'll use less energy cooling the room down later than if you had left the unit running.

- Place room air conditioning units on the cool (north) side of the house, if possible. If your air conditioner is in direct sunlight, cover it with an awning, but make sure it does not trap hot air in the window area.

- A room air conditioner of adequate capacity can serve a zone much larger than a single room, providing construction of the building is such as to permit the free circulation of air in the area.

- If you have a room air conditioner, be sure that the air exchange control, which is a means of bringing in outside air to replace stale air, is closed during the day. When it is open on hot days, this outside air, which is inefficient to cool is being introduced into the system.

•Set your thermostat at 78 degrees, a reasonably comfortable and energy-efficient indoor temperature.

The higher the setting and the less difference between indoor and outdoor temperature, the less outdoor hot air will flow into the building.

•Don't set your thermostat at a colder setting than normal when you turn your air-conditioner on. It will NOT cool faster. It WILL cool to a lower temperature than you need and use more energy.

•Set the fan speed on high except in very humid weather. When it's humid, set the fan speed at low; you'll get less cooling but more moisture will be removed from the air

•Clean or replace air-conditioning filters at least once a month. When the filter is dirty, the fan has to run longer to move the same amount of air, and this takes more electricity.

•Don't put anything directly in front of your air conditioner. Furniture, draperies, and other objects will block the flow of cool air.

•Never operate a window or attic fan in an air conditioned area. If will simply force the cooled air out of the room.

•Keep all windows and doors closed while your air conditioner is in operation.

•Expect three benefits from a service call for your air conditioner: cleaning the filters, checking the refrigerant in the system, and cleaning the condenser.

•Confine your living spaces to fewer rooms, and close off the rooms you are not using.

2 – Evaporative Type Air Conditioners

•In dry climates such as Colorado, it is wise to consider evaporative cooling. These devices, which use less energy, evaporate water to lower the temperature of a stream of outdoor air circulated through the house.

To insure maximum efficiency from an evaporative cooling unit, replace the cooling pads at the beginning of the summer season. Clean the unit thoroughly and oil motor and blower bearings. Check the water pan and recirculation system for leaks.

Test the unit to make sure that the water distribution lines keep the entire pad surface wet but don't flood the pads, which will restrict air flow.

Air balance each room. Open the window furthest from the cooler duct in each room about one inch. Unlike refrigeration, evaporative coolers depend on open windows to work properly.

3 – Cooling Without Air Conditioning

It is possible to maintain a comfortable home in summer in parts of Colorado without relying on a mechanical cooling system. As a matter of fact, many families do. Most of the suggestions already offered on proper insulation are as beneficial to cooling in summer as they are to heating in winter.

A number of the ideas offered in this section, while aimed at reducing air conditioning loads, are just as useful to families who do not use air conditioning.

•Take advantage of the daily temperature cycle — to invite night's cool air into your home and to button up the house come morning. Lowest air temperatures usually occur from midnight to just before dawn.

•A new house can be oriented to take advantage of solar and climatic conditions. Rooms can be oriented accordingly — bedrooms, for example, might be located in the east so they will not receive the rays of the late afternoon sun.

•When ventilating, draw in air from the coolest side of the house. Expel warm air from the upper parts of the house, either into the attic or through windows near their tops. A ventilator fan can be effectively installed into the upper ceiling to pull air through and push it into the attic. Also, consider installing an attic fan to exhaust heat which often reaches 140° - 160°, thus preventing the heat from radiating down to your living area.

•Take advantage of all possible ways of reducing solar heat gain. Remember to draw the blinds and draperies of windows exposed to direct sunlight. Awnings can be a more permanent method.

•Plant deciduous trees on the sunny sides of the house for summer cooling.

•On cooler days and during cooler hours, open the window or use attic or window fans instead of an air conditioner; the cooling breeze will be even more enjoyable since it is much cheaper to operate a fan than an air conditioner.

ENERGY CONSERVATION BULLETIN 2.9.1
Humidity Control

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Types Of Humidifiers

In tightly built modern houses, too little humidity is seldom the problem. However, in large houses with few occupants or in houses where little cooking or clothes washing or drying is done, there could be a problem of dry air in the winter. Moisture can be added mechanically by commercially available humidifiers. There are three general types available:

The pan type is the simplest but has limited capacity. The pan is inserted in the plenum of the furnace and wicking plates are used to draw water out of the pan where it is then evaporated into the air stream flowing over the plates.

The wetted-element type operates as air is forced through a wetted pad or filter. These units can be either portable or mounted on the furnace. Portable units are usually refilled manually and require more attention than the permanently installed humidifiers.

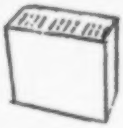
The atomizing type throws water in fine droplets from the surface of a rapidly revolving disk or a small nozzle. This type is available as a portable unit or installed in the duct or plenum of a central heating system. The minerals in hard water are left as the water evaporates, and a light coating of white dust can result over much of the furnishings in the house. In the two types previously listed, the minerals remain in the plates or pad and are discarded as their parts are replaced.

Humidifiers are controlled by humidistats and should be closely watched so that high humidity does not occur on extremely cold days when condensation is most likely to occur. Moisture accumulation on the inside surfaces of double glazed windows is the first indication of excessive humidity. If the outdoor temperature is 0° to 10°, the humidity should be no more than 20 percent; if 15° to 45°, 40 percent.

In the winter, a humidifier can relieve uncomfortable dryness, but it won't reduce utility bills. Don't believe advertisements telling you otherwise.

Humidity Control Equipment

Portable Humidifier



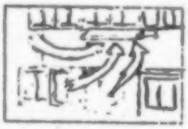
Place where needed.

- Easily moved.
- Lower initial cost than console.
- Automatic operation.

Console Humidifier

Place in central location about six inches from a warm, inside wall.

- Large capacity.
- Automatic moisture dispersion.
- Some models have automatic water refill.



Ventilating Fan

Placed in wall or ceiling of kitchen and bath.

- Operated only when needed.
- Can be automatically controlled by humidistat.

Dehumidifier

Placed near sources of excess water vapor, such as kitchen or bathroom.

- Easily moved.
- Automatic dehumdification.
- Some units have automatic drain.

ENERGY CONSERVATION BULLETIN 3.2.1

Kitchen Appliances

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While you're thinking about your food budget, think about your energy budget too. The meals you prepare, what you cook in and how you cook can make a difference

Range & Oven

•Preheating is no longer recommended by some oven manufacturers; consult the operating manual. If preheating is needed, don't wait longer than 10 to 12 minutes. Once it is preheated, immediately put the product to be baked into the oven. Many casseroles and meats do not need a preheated oven. The broiler does not require preheating unless a recipe specifically calls for it.

•Cook by time and temperature for best results. Use a meat thermometer when roasting to prevent overcooking and additional energy costs. Careful timing of cooking procedures eliminates the need to check food constantly. Every time you peek under the lid of a pan, heat is lost.

•Heating elements on an electric stove store a great amount of energy even after they are shut off. You can continue to cook after this shut-off period for about two or three minutes. Electric oven retains heat from 15 to 30 minutes. Use leftover heat to warm plates or heat rolls.

•Place your pans on the range before you turn it on to save heat. Be sure to match pots and pans to the right size unit so you don't waste heat around the sides of the vessel.

•Keep the kitchen clean. Make sure that the appliances are operating economically by regularly cleaning the exhaust fans, range top and oven.

•Clean reflector pans under surface units of an electric range will increase efficiency.

•Never boil water in an open pan. Water will come to a boil faster and use less energy in a kettle or covered pan. As soon as water reaches the boiling point, you can cut the setting back.

•Try to cook food on lowest possible setting. Many times high heat will overcook food and waste energy. The lower the setting the less energy used. (Potatoes will boil just as well at medium heat as at high heat.)

•Use a small amount of water to cook vegetables. They will cook faster, taste better and contain more vitamins. If the oven is to be used, then cook the whole meal in it. Leave 1½ inches between pans and there will be no absorption of odors.

•Preparing larger quantities of food is a good way to conserve energy. Stews, soups, spaghetti sauce, and casseroles should be prepared ahead and then frozen. It cost less to store and warm them as needed than to cook them from scratch for each meal. Besides this saves a good deal of time in the kitchen, time that can be better used somewhere else.

•A self-cleaning oven is designed with thicker insulation and uses less energy for normal oven cooking than ranges without the self-cleaning feature. A major manufacturer reports that tests conducted by its engineers have shown that a self-cleaning oven uses about 15% less energy than a non-self-cleaning oven. This margin of energy conserved is equal to the energy needed for 12 oven cleanings per year.

•Do not use aluminum foil to line the oven unless manufacturer's instructions permit it. It can reduce the oven's efficiency by interfering with air crculation.

•Plan outdoor meals. Especially in the summer, outdoor barbecues are fun, save energy and keep the house from heating up.

•Energy can be saved by using alternative cooking methods such as electric frypans, broilers, crock pots, toaster-ovens, rotisseries and microwave ovens. Many of these appliances also cut down on dishwashing by cooking more than one thing at a time in a single container. An electric frypan can be used to cook several items at a time by dividing the interior with an aluminum foil insert. It will heat more efficiently than a pan on the stove because the electric heating element is part of the pan. This gives even, well distributed heat on entire surface of the fry pan.

•Use these appliances as the manufacturer suggests. Never pull the cord when disconnecting an appliance from the outlet . . . use the plug.

•Set up a summer kitchen outdoors to eliminate all cooking heat, moisture, and odors from the house. Appliances such as skillets, pressure cookers, and toaster ovens can easily be used out on the patio.

•Investigate recipes. Many of these appliances are very versatile and can cook a wide range of items. For instance, a crockery slow cooker can be used to cook soup, roasts, bread and even cake.

•Another great alternative is the electric barbeque. It not only saves pan washing, but doesn't heat up the kitchen. Many feature special easy-to-clean grills, too.

Dishwashing

•The average dishwasher used 14 gallons of hot water per load. Use it in an energy efficient manner.

•The "rinse-hold" control on dishwashers uses three to seven gallons of hot water each time used. Avoid using it.

•Scrape dishes before loading them into the dishwasher so you won't have to rinse them. If they need rinsing, use cold water. Also check the filter screen over the drain in the dishwasher regularly and remove any food particles.

•Load the dishwasher correctly in order to ensure operating efficiency.

•Use the manufacturer's directions in measuring detergent. Too much detergent will over load the machine and cause it to work inefficiently.

•Be sure your dishwasher is full, but not overloaded, when you turn it on.

•When buying a dishwasher, look for a model with air-power and/or overnight dry settings. These features automatically turn off the dishwasher after the rinse cycle.

•Use a steamer or pressure cooker to cook several foods at one time when possible. Many pressure cookers have partition inserts so three or four items can be cooked at once. A pressure cooker takes less energy and time than conventional cooking.

•Slow-cookers consume very small amounts of electricity and do not overheat living spaces — try using yours instead of your oven.

•Research on energy consumed in cooking indicates that microwave cooking is the best energy conserver. It is four times as efficient as conventional cooking. There is no preheating and no heat given off into the kitchen.

•Remember, heating elements are the greatest pullers of wattage we have in our home. Plan their use wisely. Appliances with heating elements are: toasters, electric heaters, irons, electric stoves, hair dryers, waffle irons, electric blankets, coffee makers and others.

•If your washer has no "air-dry" switch, turn the control to "off" position after the last rinse, crack the door and let the dishes air-dry by themselves. You'll save a third of the energy cost of automatic dishwashing.

•Don't wash dishes under hot running water or you'll be throwing away gallons of costly heated water. Close the drain, fill the sink with warm water and detergent, and rinse with a hot spray in the dish drainer.

•Install an aerator in your kitchen sink faucet. By reducing the amount of water in the flow, you use less hot water and save the energy that would have been required to heat it. The lower flow pressure is hardly noticeable.

•Use cold water rather than hot to operate your food disposer. This saves the energy needed to heat the water, is recommended for the appliance, and aids in getting rid of grease. Grease solidifies in cold water and can be ground up and washed away.

3.2.3

Refrigerators

•When buying a new refrigerator, consider that the self-defrosting type uses more electricity than the manual defrost type.

•Most refrigerators have heating elements in their walls to prevent condensation on the outside. These heaters need to be on only when the air is very humid. If you buy such a refrigerator, be sure it has a switch to turn off the heater. Make sure that the refrigerator is the best size for the family needs. A half empty refrigerator is wasting energy.

•Check seals around the refrigerator and oven doors to make sure they are air tight. If not, adjust the latch or replace the seal.

To check the tightness of the seal, place a dollar bill between the gasket and the cabinet of the refrigerator and close the door. Pull the dollar bill straight out. There should be some resistance. Test all around the door. If there are places where no resistance is noticeable, have the gasket checked or replaced.

•Don't keep your refrigerator freezer too cold. Recommended temperatures: 38 to 40 degrees for the fresh food compartment of the refrigerator; 5 degrees for the freezer section. (If you have a separate freezer for long-term storage, it should be kept at 0°F., however.)

•Buy an inexpensive refrigerator thermometer to keep a check on the inside temperature.

•Every time the door is opened, cold air rushes out and the refrigerator or freezer has to work hard to compensate for the loss. Plan ahead and know what is needed before opening the door. When unpacking groceries from the store, stack all the refrigerated and frozen items in separate piles. Then put them in the refrigerator all at one time, opening the door only once.

•Assure proper ventilation to lower refrigerator and freezer operating costs. Install the unit in an area with adequate air flow and clearance from the walls and cabinets.

•Open your refrigerator and freezer as seldom and for as short of period of time as possible.

•Locate the appliance away from the direct flow of warm air such as that from a range, heat register or sunshine.

•Cool foods before refrigerating. Be careful, however, not to let things set out any longer than it takes to come to room temperature. That way, bacteria won't have a chance to grow.

•Cover all liquids stored in the refrigerator (especially frost-free models). Moisture is drawn into the air from uncovered liquids making the refrigerator work harder. When the refrigerator or freezer is full, allow for air ciculation around the stored items for proper cooling.

•Manual refrigerators and freezers consume less energy than those that defrost automatically. But they must be defrosted frequently and quickly to maintain that edge. Frost should never be allowed to build up to more than ¼ inch.

•Once a year vacuum out the back of your refrigerator. Pull it out from the wall, disconnect the electric plug and vacuum the large expose coil which usually runs the length of the refrigerator.

•While on vacation, raise the temperature setting slightly. Since the door won't be opened, things will stay cold. If the vacation is going to be for more than a week, refrigerators and freezers may be cleaned out, turned off, unplugged, and left open.

•Keep an up-to-date inventory of the food in your freezer. Indicate the location of each item. When you want something, you'll know where it is. Then the freezer cover or door won't have to be open so long.

•A chest freezer allows less cold air to escape when opened than does an upright since cold air settles to the bottom.

•Use an ice bucket when ice is going to be used for several things. This will prevent having to open the door repeatedly to fill a single glass.

ENERGY CONSERVATION BULLETIN 3.3.1

Laundry Appliances

Intermountain Rural Electric Association 303 794 1535
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You can save considerable amounts of energy in the laundry through conservation of hot water and by using your automatic washers and dryers less often and more efficiently.

Make sure that the washer and dryer are the right size for the family. A machine that is too small will waste energy by making it necessary to do two or three loads when a large machine could have done one.

Keep laundry equipment clean. Clean the lint filters on both machines after each load. A clogged lint trap or filter reduces efficiency and increases energy use.

Washers

One of the greatest energy users and costs in washing clothes is the heating of the water.So think cold.

- Experiment with the best way of washing for the family. To avoid overwashing, which wastes water and energy and shortens the life of clothing, try presoaking soiled things.
- Always presoak badly soiled clothes.
- If your machine has a soak cycle, take full advantage of it. You might be able to remove stubborn stains with just one washing.
- Don't use too much detergent. Follow the instructions on the box. Oversudsing makes your machine work harder and use more energy.
- Use the suds saver if you have one. It will allow you to use one tubful of hot water for several loads.
- Don't wash partial loads. Wait until you can fill the machine. You'll save time, electricity and hot water. A full load is when the tub is three-quarters full of dry, loosely packed articles.
- If you must wash a partial load select the water level to fit the amount of clothes. Some machines have "mini cycles" which allow for just this use of the washer.
- Wash clothes in warm or cold water, rinse in cold. Use hot water only if absolutely necessary. Many detergents are designed to clean just as well in cold water. Your clothes will fade less and have fewer wrinkles. That might save you some ironing too.
- Short cycles. If your washer has a timer, use the shortest cycle possible. Regular clothes need only an 8-10 minute wash. Delicate clothes don't need as long a wash cycle as dirty work clothes.
- Clean the filter to make your machine run efficiently. Some machines have a self-cleaning filter, in which case, it will take care of itself.
- If you have a laundry tub next to your washer, save the hot sudsy water from the wash to clean barbecue grills, garden tools, oven racks, etc.
- Shut off the water supply to the washer when it is not being used. This prevents loss and damage in the event of a broken hose, as well as relieving pressure on the water valves. It is a good idea to shut off the water when leaving on vacation, too.

3.3.2

Dryers

- Separate drying loads into heavy and lightweight items, since the lighter one takes less drying time.
- Two half-loads take less time and require less electrical energy to dry than one full load in many cases.
- Specific drying settings are recommended for different fabrics. Follow the directions. You don't need "hot" heat for permanent press, for example. The "Warm" setting will dry some items wrinke free, if you remove them as soon as they are dry.
- Fill clothes dryers but do not overload them. That makes it work harder and longer. It wastes electricity and money.
- Dry your clothes in consecutive loads. The energy used to bring the dryer up to the desired temperature shouldn't be allowed to go to waste.
- Use leftover heat to dry light synthetic garments and only partially dry items which are to be pressed immediately.
- Set your dryer for "damp dry" if you are drying clothes that require ironing. Or take them out while they are still a little damp. . . and just right for ironing. Remove clothing that needs to be pressed before they are completely dry and damp press.
- "Over-drying" is the most common waste of electricity. And over-drying causes wrinkles and makes clothes wear out faster.
- If your dryer has an automatic dry cycle, use it.
- Save energy by using the old-fashioned clothesline. As a bonus, outdoors in fine weather clothes get a fresh sunshine smell. On bad winter days, if you have a warm cellar and some extra space, consider hanging a clothes line to dry clothes.
- Keep the lint screen in the dryer clean. Remove lint after each load. Lint impedes the flow of air in the dryer and requires the machine to use more energy. Your clothes will come out better as well.
- Try to place the dryer in a warm area of the home. Your dryer will have to operate longer in an unheated garage or utility room because the cool air taken in must be warmed more than air that is already warm.
- Vent your dryer to increase its efficiency. Occasionally check the vent to make sure it is not clogged. A clogged vent can cause your dryer to consumer needless energy and presents a potential fire hazard.

Ironing

- When possible, do all the ironing at one time to prevent having to heat the iron several times a day or week. Use the stored heat in the iron after it is turned off to press delicate fabrics. When the iron is off, unplug it
- You can save ironing time and energy by "pressing" sheets and pillow cases on the warm top of your dryer. Fold them carefully, then smooth them out on the flat surface.
- Save energy needed for ironing by hanging clothes in the bathroom while you're bathing or showering. The steam often removes the wrinkles for you.

ENERGY CONSERVATION BULLETIN 3.4.1

Other Appliances

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The foundation of satisfactory electrical use is the home wiring system. If the wiring system is not big enough to carry the home's load, efficient operation of the appliances and electric equipment can be impaired. Be sure that there is adequate wiring for the family appliances.

Do not use extension cords if possible.

Make sure that an appliance is off before plugging it in. when unplugging, grasp the plug and not the cord.

- If a three-prong plug won't fit the socket, don't remove the third prong; get an adapter for the wall socket.

- Don't overload electrical circuits. This results in reduced energy efficiency and also can create a safety hazard. If you're unsure of circuit capacity or attached load, call your electrician.

- Become thoroughly familiar with the operation of all your appliances. Read the "use and care" book to make sure you are not wasting energy by using the appliance incorrectly.

- Don't put off needed repairs. Worn parts may increase energy use needlessly as well as putting excessive wear on other parts. This will cause more costly repairs later.

- Keep moving parts of appliances free from dust and grime so they can move freely.

- Heating elements are the greatest pullers of wattage we have in our home. Plan their use wisely. Appliances with heating elements are: toasters, electric heaters, irons, electric stoves, hair dryers, waffle irons, electric blankets, coffee makers and others.

- Before buying new appliances with special features, find find out how much energy they use compared with other, perhaps less convenient, models. A frost-free refrigerator, for example, uses mor energy than one you have defrost manually. It also costs more to purchase. The energy and dollars you can save with a manual-defrost model may be worth giving up the convenience.

- Another source of wasted energy can be easily controlled by simply taking care to turn off radios, televisions, stereos or any other kind of appliance when not being used.

- As a general rule, small appliances use less energy than large ones. Therefore, using a small appliance in place of a large one whenever possible conserves energy. For example: toasting bread in the oven uses three times more energy than toasting it in a toaster.

- While all of of the small appliances in the house generally will add on more than a few dollars to the monthly electric bill, it is still wise to extend good energy use habits to them too.

- Items like electric clocks are low wattage users, and they don't contribute very much to your bill. Similarly, items that are used for brief periods, like carving knives, tooth brushes, and small tools, have very little effect on your bill.

- When no one is watching television or listening to the radio, sets should be turned off. Instant-on TV sets draw electricity 24 hours a day. Some sets have switches to turn off the instant-on feature during hours when not in use. If you do not have this feature, unplug the TV set. As an alternative you can buy a special extension cord with an OFF-ON switch at its end or check with your TV serviceman to see if he can place an on-off switch on the cord to the wall plug.

- If buying a new TV set, look for the solid-state type. It uses less power than the older tube type. Color television sets use more electricity than black-and-white sets.

- Do not pre-heat appliances such as stoves, frypans, irons and the like any longer than necessary; these are big energy-users.

- A vacuum cleaner will operate more efficiently if it is cleaned and the bag is emptied regularly. Watch for a buildup of hair or string on the brushes which slows their movement and impedes the cleaning ability. Never vacuum over electric cords.

- Electricity has made many jobs easier in the home workshop. To help keep all electrical servants working well, follow a procedure of regular maintenance and cleaning of all equipment.

  Always make sure there is a good connection. Avoid accidental starting of appliances by making sure the switch is off before plugging in the cord. Also, disconnect tools before servicing or changing accessories.

  Ground all tools unless they are double insulated. Never remove a third prong from a plug . . . get an adapter.

  Never carry a portable tool by the cord.

- Take showers rather than tub baths but limit your showering time and check the water flow if you want to save energy. It takes about 30 gallons of water to fill the average tub. A shower with a flow of 4 gallons of water a minute uses only 20 gallons in 5 minutes. Assuming you use half hot and half cold water for bathing, you would save about 5 gallons of hot water every time you substitute a shower for a bath. Thus, if you substituted just one shower for one bath per day, you would save almost 2,000 gallons of hot water in a year.

- Consider installing a flow restrictor in the pipe at the showerhead. These inexpensive, easy-to-install devices restrict the flow of water to an adequate 3 to 4 gallons per minute. This can save considerable amounts of hot water and the energy used to produce them over a year's time. For example, reducing the flow from 8 to 3 gallons a minute would save the average family about $24 a year.

- Don't scrub nails or wash hands under a running stream. Fill sink for washing and rinsing. You use half as much heated water.

- A leak of one drip per second in a hot water tap will pour 2,500 gallons of hot water down the drain over a one year period. You pay not only for the water, but the fuel it takes to heat it.

- While you're on vacation, give your energy bill a break too. Turn your electric water heater off at the circuit breaker. When you return, run some water from a hot water faucet to make sure there is water in the heater.

ENERGY CONSERVATION BULLETIN 3.4A.1

Appliances: Energy Use And Operating Costs

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This table lists common household appliances, their average wattage, the national average usage and the average cost to operate that appliance for one month. The purpose of this table is to point out to you, the Intermountain member consumer how your home uses electricity.

It should be emphasized that these are only national averages. Individual households can and do vary widely depending on the efforts made in each home to save money by conserving electricity.

		Average Wattage	Average Hours Used per Month	Aprox. KWH Used per Month	Avg. cost per Month at 3½cents per KWH
FOOD PREPARATION	Blender	386	3	1.3	$ .05
	Counter Top Oven/Broiler	1,436	6	8.5	.30
	Coffee Maker	894	10	9	.32
	Dishwasher	1,201	25	30	1.05
	Frying Pan	1,196	13	15.5	.54
	Hot Plate	1,257	6	7.5	.26
	Mixer	127	8.5	1	.04
	Microwave Oven	1,450	11	16	.56
	Range with Oven	12.200	8	98	3.43
	with self-cleaning oven	13,200	8.25	100	3.50
	Toaster	1,246	3	3	.11
	Trash Compactor	400	1	4	.14
	Waffle Maker	1,116	1.5	2	.07
	Waste Disposal	445	6	2.5	.09
FOOD PRESERVATION	Freezer (15 cu. ft.)	341	292	100	3.50
	Freezer (frost free 15 cu. ft.)	440	333	147	5.15
	Refrigerator/Freezer (14 cu. ft.)	326	291	95	3.33
	Refrigerator/Freezer (frost free 14 cu. ft.)	615	248	152	5.32
COMFORT CONDITIONING (Seasonal-all figures will vary depending on weather and specific size of unit.)	Air Conditioner (room)	860	380	309	10.82
	Electric Blanket	177	69	12	.42
	Dehumidifier	207	244	63	2.20
	Fan (window)	200	141	28	.98
	Heater (portable)	1,322	45	59	2.07
	Heating Pad	65	13	1	.04
	Humidifier	177	72	41	1.44
	Lights (small home)	1,000	Varies	100	3.50
	Lights (large home)	4,000	Varies	200	7.00
HOME HEATING (Figures are for highest month of heating season.)	Heat Pump (2½ ton for 1200 sq. ft. home at 30° outside)	3,110	540	1,579	58.77
	Baseboard Heater (1000 sq. ft. house)	8,000	300	2.400	84.00
	Baseboard Heater (1600 sq. ft. house)	12,000	300	3,600	126.00
	Oil Furnace (blower, etc.)	600	125	75	2.63
	Electric Furnace (1200 sq. ft. house)	20 000	540	4,800	168.00
HEALTH AND BEAUTY	Hair Dryer	1,000	3	3.0	.11
	Electric Razor	14	10	.2	.01
	Tooth Brush	7	6	.04	1/10 cents
LAUNDRY	Clothes Dryer	4,856	17	83	2.91
	Iron (hand)	1,008	12	12	.42
	Washing Machine (non automatic)	286	22	6	.21
	Washing Machine (automatic)	512	17	9	.32
	Water Heater (quick recovery)	4,474	90	401	14.04
HOME ENTERTAINMENT	Radio	71	100	7	.25
	Radio/Record Player	109	83	9	.32
	Television black & white tube type	160	182	29	1.02
	solid state	55	181	10	.35
	color tube type	300	183	55	1.93
	solid state	200	183	37	1.30
HOUSEWARES	Clock	2	720	1.5	05
	Sewing Machine	75	12	1	04
	Vacuum Cleaner	630	6	4	14

ENERGY CONSERVATION BULLETIN 3.4B.1
Buying Appliances

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It's no longer enough to know the size, features, service and warranty you desire in an appliance. With the electric energy costs of today, and those forecast for the future, smart consumers will begin considering the life-cycle cost of major appliances . . . in particular, the operation costs, just as they do with automobiles.

WHAT ARE LIFE-CYCLE COSTS?
The life-cycle cost of a product is the total amount spent for and on a product during its usable life. This includes the initial purchase price; installation, maintenance, and service charges; and energy costs; less any trade-in value. Here are examples of life-cycle costs from a recent study furnished by the Association of Home Appliance Manufacturers:

*For a color TV with a life expectancy of 10 years, 53 percent of the life-cycle cost is in the purchase price, 12 percent is energy and 35 percent is service.

*For a refrigerator with a life expectancy of 14 years, the purchase price accounts for 36 percent of the total cost; energy, 58 percent; and service, 6 percent.

Energy cost differences, between the two can be explained by the fact the refrigerator is "on" almost constantly while the TV is using energy only at those times selected by the owner.

As you can see, with energy costs being a major expense during the life of the refrigerator, it makes good sense to purchase the most energy-efficient refrigerator you can afford.

HOW TO ESTIMATE LIFE CYCLE ENERGY COSTS

APPLIANCE	AVERAGE WATTAGE	ESTIMATED KWH USE PER YEAR ×	LIFE EXPECTANCY ×	AVG. COST PER KWH =	ESTIMATED LIFE CYCLE ENERGY COSTS
Freezer, 15 cubic foot	341	1,195	20 years	.05¢	$1,195 for 20 years
Frostless, 15 cubic foot	440	1,761	"	.05¢	$1,661 for 20 years
Refrigerator 12 cubic foot	241	728	15 years	.05¢	$ 546 for 15 years
Frostless, 12 cubic foot	321	1,217	"	.05¢	$ 913 for 15 years
Electric Range with oven	12,200	1,175	12 years	.05¢	$ 705 for 12 years
Electric Range w/self-cleaning oven	12,200	1,205	"	.05¢	$ 723 for 12 years
Dishwasher	1,200	363	11 years	.05¢	$ 200 for 11 years
Automatic washer	512	103	11 years	.05¢	$ 57 for 11 years
Electric clothes dryer	4,856	993	14 years	.05¢	$ 695 for 14 years
Color TV (tube)	300	660	12 years	.05¢	$ 396 for 12 years
Color TV (solid state)	200	440	12 years	.05¢	$ 264 for 12 years
	160	350	11 years	.05¢	$ 193 for 11 years
B/W TV (solid state)	55	120	11 years	.05¢	$ 66 for 11 years
A/C (room)	860	860	12 years	.05¢	$ 516 for 12 years
Water heater	2,475	4,811	10 years	.05¢	$2,406 for 10 years

To use the chart, insert your average cost per KWH in column 5. Then multiply the KWH use by the number of years times the average KWH cost. This will give you a good idea of what it would cost you to operate an appliance with this wattage during its life cycle.

3.4B.2

LOOK FOR THE "EER" OR ENERGY EFFICIENCY LABELS

It will pay to look for energy-efficiency labels on appliances when you shop. By 1980, all applicances will have an energy-use rating of some type attached to them at the point of sale. You can use them for comparison of models to make a wise purchase.

This labeling program is designed to help consumers shop for energy-saving household appliances and equipment. It is being developed by the Federal Energy Administration and the Federal Trade Commission as a result of the Energy Policy and Conservation Act, signed into law on December 22, 1975.

Under that law, manufacturers must place labels showing estimated annual operating costs on all models of the following:

- Central air-conditioners
- Clothes dryers
- Clothes washers
- Dishwashers
- Freezers
- Furnaces
- Home heating equipment not including furnaces
- Humidifiers and dehumdifiers
- Kitchen ranges and ovens
- Refrigerators and refrigerator-freezers
- Room air-conditioners
- Television sets
- Water heaters

Appliance testing, labeling, and public information procedures are currently being developed. You should be hearing about the appliance labels, as they become available in 1978 and 1979, through Government information programs.

For further information about the appliance labeling program, write the Federal Energy Administration, Appliance Program, Washington, D.C. 20461.

Currently, air conditioners carry "EER" labels. The EER is the energy efficiency ratio of the unit which has been determined by dividing the BTU-per-hour output by the electrical input in watts. The higher the EER number, the more efficiently the unit will operate.

Be prepared to pay a higher purchase price for a unit with a high EER; but over the usable life of the air conditioner, savings in cost of operation can more than balance the original price. Here's a comparison of two 12,000-BTU air conditioners, based on 12 years life expectancy at 5c per KWH.

Typical Cost	**A/C 1, EER 5**
Purchase Price	$210
Energy Cost	720
Service Cost	118
Life-Cycle Cost	$1048

Typical Cost	**A/C 2, EER 10**
Purchase Price	$255
Energy Cost	360
Service Cost	95
Life-Cycle Cost	$710

Refrigerators and freezers are harder to pin down in terms of energy efficiency, because the use (number of times the doors are opened, etc.), and features are a big determinant in how much electricity is used. However, monthly KWH-use estimates are available at point of purchase. Be sure to ask for them.

BE ENERGY-WISE IN PURCHASE AND USE

Along with figuring life-cycle energy cost estimates, comparing energy-efficiency labels, look also for specific energy-saving features on appliances. And, after delivery, be sure to read the use and care instructions furnished by the manufacturer. Learn to use your equipment properly; to do otherwise defeats the goal of wise energy use and can cost you dollars in service calls.

ENERGY CONSERVATION BULLETIN
Lighting

Intermountain Rural Electric Association 303 794 1535
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Explanation of Terms

Watts indicate the amount of electricity consumed by the bulb not the amount of light. The amount of light is measured in lumens. Carefully study bulb packages to get the most light per wattage.

Lumens are a measure of the quantity of light the bulb emits (two bulbs with the same wattage may differ in amount of lumens, or light actually emitted)

The **efficiency** of incandescent bulbs increases as the wattage increases. That means, for example, that you get more light from one 100-watt bulb than from two 50-watt bulbs, even though they use the same amount of energy.

Bulb life indicates approximately how long the bulb will last before burning out.

In General

•If you are presently using long-life or 130-volt extended service bulbs, changing to 120-volt standard bulbs of lower wattage will maintain your present light output at fewer watts and lower cost. Use long-life incandescent bulbs only in hard-to-reach places.

•We recommend using only 120-volt rated bulbs for most efficiency. By changing from a 100-watt, 130-volt bulb to a 75-watt standard life, you'll get nearly 4% more light and save kwhs (based on 12 hours per day use on 120-volt line).

•Instead of using overhead lights to light an entire room, try concentrating the light on the areas you'll be working in. This can be done with desk lamps, floor lamps, hanging lamps and pole lamps. If light is concentrated on work areas, in most cases you won't need as much light. It could be better for your eyes, too, when doing very close work.

•Use low wattage bulbs for decorative purposes, and higher wattages for such tasks as reading, sewing and other sorts of close work.

•Examine all light fixtures in your home to see if you are using more light than you need. You may find this especially true in hallways. If so, replace bulbs with those of less wattage.

•Use one large bulb in preference to three smaller ones where bright light is needed. A 100-watt lamp will provide better reading light than three 40-watt bulbs.

•Try 50-watt reflector floodlights in directional lamps (such as pole or spot lamps). These flood lights provide about the same amount of light as the standard 100-watt bulbs but at half the wattage.

•Try 25-watt reflector flood bulbs in high-intensity portable lamps. They provice about the same amount of light but use less energy than the 40-watt bulbs that normally come with these lamps.

•Normally this can be done without a loss of lighting level because the reflector bulb reflects more light out of the fixture into the room area. Also, there is less heat buildup which aids in longer life for the bulb.

•Turn off all but one or two low-watt lamps when watching TV. You only need enough light to balance TV brightness and avoid eyestrain.

•Use low-wattage night light bulbs. These now come in 4-watt as well as 7-watt sizes. The 4-watt bulb with a clear finish is almost as bright as the 7-watt bulb that uses about half as much energy.

Fluorescent Lighting

•Use fluorescent lights whenever you can; they give out more lumens per watt. For example, a 40-watt fluorescent lamp gives off 80 lumens per watt and a 60-watt incandescent gives off only 14.7 lumens per watt. The 40-watt fluorescent lamp would save about 140 watts of electricity over a 7-hour period.

The life of a fluorescent lamp is up to 10 times that of an incandescent lamp. With fluorescent lighting there's less heat build-up too.

•Consider fluorescent lighting for the kitchen sink and countertop areas. These lights set under kitchen cabinets or over countertops are pleasant and energy efficient.

•Fluorescent lighting also is effective for makeup and grooming areas. Use 20-watt deluxe warm white lamps for these areas.

•A 40-watt WWX (warm white deluxe) fluorescent lamp produces more lumens than a 100-watt incandescent bulb while consuming approximately half the energy. (Some wattage is consumed by the fluorescent lamp ballast).

100-watt incandescent bulb = 1,750 lumens
40-watt fluorescent WWX = 2,150 lumens

•Deluxe warm white fluorescent is recommended for home use because it produces the most pleasing color light that enhances food and facial complexions. Standard cool white tubes may be used in workshops and garages to gain more light output than the deluxe type.

•Turning off lights in unused rooms can result in savings. And contrary to some popular beliefs, turning a light on and off does not use more electricity than leaving it on. But in the case of fluorescent lighting, the life of the fluorescent tube is shortened about two hours each time it is turned off and restarted.

Other Tips

•Use daylight to its best advantage.

•Turn off all lights when not needed. There is no extra power used in turning a light on or off.

•Install light switches at each door in rooms with multiple exits to encourage turning off unneeded lights.

•Keep all bulbs and shades clean. Dirt absorbs light.

•You can save on lighting energy through decorating. Remember, light colors for walls, rugs, draperies, and upholstery reflect light and therefore reduce the amount of artificial light required.

•Consider three-way bulbs in reading lamps, etc. Three-way sockets can be easily installed into existing lamps at a nominal cost. Three-way bulbs provide a choice of lighting levels, high for seeing tasks, medium for less-demanding activities, low for safety. At low level, much less energy is used.

•Install dimmers where feasible. In dining, living and sleeping areas the use of dimmers can be an excellent aesthetic advantage as well as save energy. Action of the dimmer reduces the light level when higher amounts are not needed by lowering the flow of power to the fixture, thus saving electricty. A bonus — the bulbs will last longer, too.

•Use outdoor spots, floods and driveway illumination only when necessary.

•If you need outdoor lighting for safety and security, investigate low voltage systems. They use less energy and you can do the installation yourself.

•Install time clocks or a photocell unit on indoor/outdoor security lighting. That will prevent forgotten lighting from burning in the daytime. Also, the lights will work on schedule for additional safety while the family is away.

ENERGY CONSERVATION BULLETIN 3.6.1

Fireplace Use

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In today's home, the fireplace has two main functions. It is to look warm and inviting and to supplement the primary heating system. However, you should not count on your heating bills being reduced by burning wood in your fireplace when the furnace or other primary heat source is in operation. Most of the heat gained from the wood burning goes up the chimney plus an estimated 20 per cent of the warm air already in the home.

This is because the common fireplace in most homes today is only about 10 per cent efficient, even when well designed and constructed.
Significant modifications are possible however, that can increase this efficiency up to 50 per cent.

Combustion Air

A fire in a conventional fireplace requires large quantities of air for necessary combustion.

In a properly operating fireplace, between 500 and 600 cfm of combustion air will be drawn up the chimney. This occurs whether there is a roaring fire or a smoldering fire.

Unless special provisions are made, combustion air for a fireplace comes from inside the house. This may be air which was heated by a central heating system. It must be replaced by outside air if the fireplace is to operate properly.

Tightly constructed houses will normally average less than one complete air change per hour. For proper operation of a fireplace, there must be five or six air changes.

Several solutions address this problem:

•Install a vent for obtaining outside air if at all feasible or an air inlet grill in the hearth at the front of the fireplace to obtain combustion air from basement, crawl space or outside. If this isn't possible and if getting a proper draft is a problem, especially while starting the fire, slightly open the window nearest the fireplace.

•Closing off the room where fireplace is in use will reduce heated air from other rooms being drawn up the chimney.

Before firing up your fireplace, turn down any other heat in the room; set the thermostat at 60 degrees or lower.

If you really want to save money, only use the fireplace when all other heating systems are off. In mild weather conditions, little or no harm can be done by burning wood. Heat will be gained from the fireplace and the early fall and late spring chill can be elinimated.

Recovering Heated Air

•Build in a metal manufactured fireplace heat exchanger. One with a small fan for circulating the hot air increases efficiency.

•Without a heat recovery device the only heat realized from a fireplace is radiant heat. Most any type of wood or coal burning space heater would be four to five times more efficient as a supplementary heating unit.

A damper regulates the air flow or draft through the fireplace. The size of the damper opening should correspond to the size of the fire. Narrow for a little fire. Wide for a big one.

All fireplaces should have a full closing, regulating type damper. If your unit doesn't have a damper, one should be added as soon as possible. A built-in damper in a brick or stone fireplace will take some masonry work. Easier to install is a chimney top damper available for all type fireplaces.

Until a damper can be installed, a flat metal plate should cover the front as tightly as possible when the fireplace isn't being used. For easier handling of the plate, drawer handles and metal shelf brackets for feet may be added.

When the fire is dying out, keep closing the damper down as far as possible without causing smoke. But as long as there are hot coals, don't close the damper completely. At this time, you should also use the flat metal plate to cover the opening to greatly reduce the loss of heated air. When the fire is out, the damper has to be closed tightly to prevent the draft from stealing heat from the room.

•Every hour, an open damper can draw as much as 20 percent of the warm air from a room. It can also cause cold drafts near windows and doors. This causes the primary heating system to operate more often, causing your heat bill to be more expensive. So keep the damper closed until you use the fireplace again.

After some practice, you'll be able to fine tune the damper to pull a draft that will draw the most heat from the least wood.

•Install a glass door firescreen of clear tempered safety glass. This reduces heat loss up the chimney when fire is smoldering. Obviously, the flat metal plate isn't needed with this type screen.

•When using a glass screen, the fireplace should have an inlet for outside air. This is necessary for better burning and to prevent the loss of heated air from the room.

•While both wire mesh and glass screens offer looks and protection, the glass screens offer the bonus of saving energy.

In a properly constructed fireplace and chimney, there is an exact ratio between the dimensions of the fireplace and the size of the flue. A flue too small in proportion to the fireplace opening, will be too small for quality of smoke-laden air to be discharged. If the flue is too large, the draft will be diluted and cut down needed air current.

Downdrafts will cause a fireplace to smoke. Downdrafts can be caused by tall trees or buildings close to the house or by the chimney being too low in relation to the highest point of the roof.

The chimney top must not be less than two feet above the highest point. Adding a few courses of bricks may be the cure. A cap over the chimney or a weathervane hood also should be considered for preventing a downdraft.

The top of the chimney should be covered with a removable one-half-inch mesh screen as a spark arrester and to keep out birds. (Never consider using ordinary screen wire; it quickly clogs with soot.)

A metal or masonry hood over the chimney top will reduce the problem of rain and will help deflect the wind, which can cause smoking problems.

For safety and efficiency, the chimney should be kept clean. From the roof, pull a heavy chain up and down inside the chimney. Or use a burlap sack filled with gravel tied to a long rope.

Leave about one inch of ashes in the hearth for insulation. The fire will start easier and burn better.

In most cases, starting the fire properly will send smoke up the flue. Always place the wood against the back wall of the fireplace. Also, while lighting the kindling, ignite a roll of newspaper and hold it high inside the fireplace opening to heat the air and produce a draft.

Once lit, keep the fire active and as far forward as possible without causing a smoking problem.

ENERGY CONSERVATION BULLETIN 3.7.1

Electric Heating Use

Intermountain Rural Electric Association 303 794 1535
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Heating System Operation

•Heating and cooling our homes account for most of our residential energy costs. Don't waste any of that precious conditioned air.

It is a good idea not to change your thermostat constantly. Find a comfortable temperature and live with it. From a health standpoint it is better to have a lower temperature than a higher one. We generally recommend leaving the thermostat at 68° F. in the wintertime. Remember, it is better to wear warm clothing than to have a hot, dry house.

•If you do not have central heating in your home then it's a good idea to shut off unused rooms and close heating vents to these areas. But you should avoid closing off more than one-third of your house at a time. (This does not apply if you have a heat pump system. Leave it alone; shutting vents could harm a heat pump.)

•If you have ceiling heat never turn thermostat high for quick heat. The cable heats gradually and there's no way to make it go faster.

•Try to avoid using portable electric heaters. They pull a lot of wattage. If you must use them, place them in smaller areas where heat will be more confined. It takes too many such heaters to keep a large room warm. They are really best for supplemental heating. And keep them away from anything that could burn.

•When entertaining a large group during the heating season, it is wise to lower the thermostat a degree or two before guests arrive. People generate heat, and the room may become overheated, forcing you to open a window.

•During the winter months when the air in the house becomes dry from heating, it's smart to use a humidifier. The moisture that's given off by a humidifier is good for your furniture, plants, and for you, too. And by using a humidifer, the temperature can be kept lower without sacrificing comfort.

•Keep heat-producing objects such as lamps radios or TV's at least three feet away from the thermostat. These objects could emit enough heat to cause your thermostat to keep your home uncomfortably cool. A thermostat should also be located away from drafts so the furnace won't continue to run when the rest of house is warm enough.

•In arranging furniture, be careful not to block heating units. Drapes which cover heating registers or restrict air flow should be shortened. Baseboard heating units need air circulation in order to operate properly.

•Use heavy or insulated draperies, keep them closed at night, and fit them tightly at the top. In the summer and in warm climates, light colored curtains that you can't see through will reflect the sun and help keep your house cool.,

•Keep doors and windows firmly shut and locked to cut down heat loss in winter and heat gain in summer. Check your windows and door latches to see whether they fit tightly and, if necessary, adjust the latches and plug any air leaks. You don't really need to open windows in winter — you usually get enough fresh air just from normal air leakage even if your house is well caulked and weatherstripped.

•When it's cold outside, draw the drapes over sliding glass doors and picture windows to create a heat barrier in front of these cold surfaces and reduce heat loss through conduction. If windows face the sun, leave them uncovered until the sun goes down.

•The tightest storm door in the world doesn't work when it's open — try to cut down the number of times that you go in and out. Adding a vestibule at your front and back doors will also help to tighten up your house.

Heating System Maintenance

•Keep those furnace filters clean. Checking them monthly is a very good habit to acquire. Your furnace always has to work harder when the air flow is restricted by dirty filters.

•Keep return heating air grills and warm-air ducts clean. Household dust and lint can overload your furnace, and clogged air ducts can keep a room from receiving sufficient heat.

•Clean your thermostat annually by removing the cover and carefully blowing away any dust which has accumulated.

•Check the duct work for air leaks about once a year if you have a forced-air heating system. To do this, feel around the duct joints for escaping air when the fan is on.

Relatively small leaks can be repaired simply by covering holes or cracks with duct tape. More stubborn problems may require caulking as well as taping.

•If the ducts for either your heating or your air conditioning system run exposed through your attic or grarage (or any other space that is not heated or cooled) they should be insulated. Duct insulation comes generaly in blankets 1 or 2" thick. get the thicker variety, particularly if you've got rectangular ducts. If you're doing this job at all, it's worth it to do it right. For air conditioning ducts, make sure you get the kind of insulation that has a vapor barrier (the vapor barrier goes on the outside). Seal the joints of the insulation tightly with tape to avoid condensation. Check for leaks in the duct and tape them tight before insulating.

•On a Baseboard System, electric or hot water, once a year remove front covers. They usually snap out or have screws holding them on. Once removed, vacuum top, front, side and bottom, using a round brush so that you will not damage the fins. (Note: on electric system, make sure electrical switch is off.) Replace covers.

•Dust or vacuum radiator surfaces frequently. Dust and grime impede the flow of heat. And if the radiators need painting, use flat paint, preferably black. It radiates heat better than glossy.

•Once a year, all upright case iron radiators should be cleaned with a raditor brush. They should be cleaned lengthwise and then sideways. It is amazing how much dust radiators collect in a period of a year. Dust will restrict the flow of heat.

ENERGY CONSERVATION BULLETIN 4.1.1

How To Engage A Contractor

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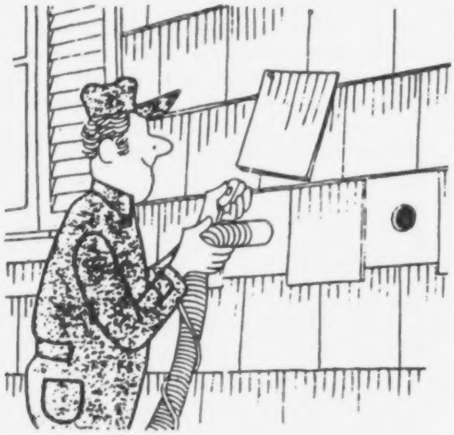
If you prefer to hire an insulation contractor, you can find one by (1) asking your gas or electric utility company for suggestions, (2) consulting friends and neighbors, (3) looking in the phone book "yellow pages" under "Insulation Contractors — Cold & Heat" or a similar heading.



The next step is to call in two or three contractors to quote your job. You should judge quality as well as price. Here are some suggestions:

1. Check a contractor's realiability with the local Better Business Bureau (also listed in the phone book).

2. Ask a contractor for references, including other home owners for whom he has done work. Check them out.

3. Give all the contractors exactly the same outline of the job. For example, say, "I want to add R-19 to my attic floor," then stay with that specification and that way of saying it. Don't be satisfied if a contractor says, "OK, I'll add 6 inches."

4. Why not automatically be satisfied with 6 inches? Because not all brands of insulation have the same heat-retarding ability — 6 inches of one brand might not be the same as 6 inches of another. Stick with R-numbers. If a contractor won't deal with you in R-number language, don't you deal with him.

5. If a contractor is going to use blown-in insulation, how can you tell if you're getting R-19 performance, or R-22, or R-11 — whatever thermal resistance rating you decide you want? It's easy if you look at the bag lable. Federal government specifications, HH-1-1030A and HH-1-515B, require that each bag of loose fill insulation be labeled as shown below. If a contractor uses insulation packed in bags that aren't labeled, don't hire him; the quality of his material will be unknown.

R value	Minimum thickness	Maximum net coverage per bag
R-22	10"	45 sq. ft.
R-19	8-¾"	51 sq. ft.
R-11	5"	90 sq. ft.

The thicknesses and coverages shown on the bag label may be different for different manufacturers.

The coverage figure gives you a means of knowing how many bags of insulation the contractor should blow into your attic floor to achieve a particular R value. Multiply the overall square-foot area of your attic floor by .90 or .94 (see page 11 of this booklet), then divide that number by the "Maximum net coverage" listed on the label for the R-number you want.

When you talk to a contractor's salesman, ask him to show you the bag label for his brand of insulation and explain it to you. (When the job is being done, stay home and count the number of bags actually used.)

6. Ask a contractor how he pays his installers — by the square footage they cover or by the hour. If he pays them by square footage, they might do a hasty job on your house just so they can get on to the next one.

7. Ask a contractor about the insurance he carries. Does he have insurance to protect his own men if they are injured? Are you covered if one of his men damages your house — say, he steps through the ceiling?

8. **Insist on a written contract.** It should specify what the job covers, including the type and amount of insulation, its "R" value (see below), the cost and the warranty coverage. A contract that specifies the contractor's responsibility for cleanup and trash removal can save you a lot of grief.

9. Practically all insulating products are flammable to some degree, and some may emit dangerous levels of smoke and toxic fumes at high temperatures. Steer clear of anyone claiming that the products he uses are problem-free. For example, cellulose insulation should be treated to reduce flammability to an acceptable level, but improper treatment can reduce thermal resistance and cause corrosion of pipes and other metal items. Mineral wool (which includes rock wool and fiberglass) won't burn, but it may be enclosed in vapor barriers made of flammable paper. Sellers may say urea formaldehyde products are fireproof, but the Consumer Product Safety Commission says this is not so. Also not fireproof are "flame-resistant" polyurethane and polystyrene products, which can be used safely only if enclosed in a flame-and-heat-retardant structure, such as gypsum board. This is also advised for insulation products made of mineral wool, cellulose and urea formaldehyde.

Test methods for flammability in insulation established through the American Society of Testing and Materials (ASTM) check the rates at which various materials create smoke, permit flames to spread and contribute fuel to the fire. However, even products that meet "acceptable" criteria may still be flammable and should not be installed near heat.

- Be alert, says the Better Business Bureau, to these tactics:

claiming an "R" value for an insulation material that exceeds the general per inch range described in this booklet;

- representing the material as non-combustible, self-extinguishing or non-burning, unless proof of such a claim is provided.

- using scare tactics such as saying that your present insulation is "inferior" or that it may burn easily, just to make a sale.

- claiming they represent a utility company. Always check this type of claim directly with the utility company.

- claiming that you will qualify for federal, state or local tax relief by installing new insulation. Unless such laws have been passed, no salesperson can promise tax relief for installing insulation of any kind. Where tax relief does become law, then be sure that materials offered meet the prescribed conditions for eligibility.

- representing that the insulation is "approved by" the Federal Housing Administration (FHA) or by any other Federal agency, or by the Underwriters Laboratories, Inc. (UL).

ENERGY CONSERVATION BULLETIN 4.2.1
Heat Flow

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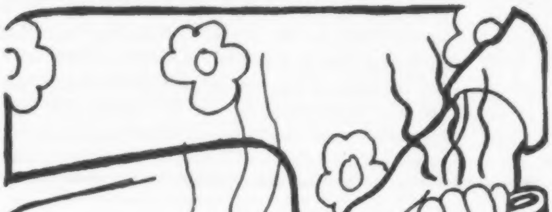
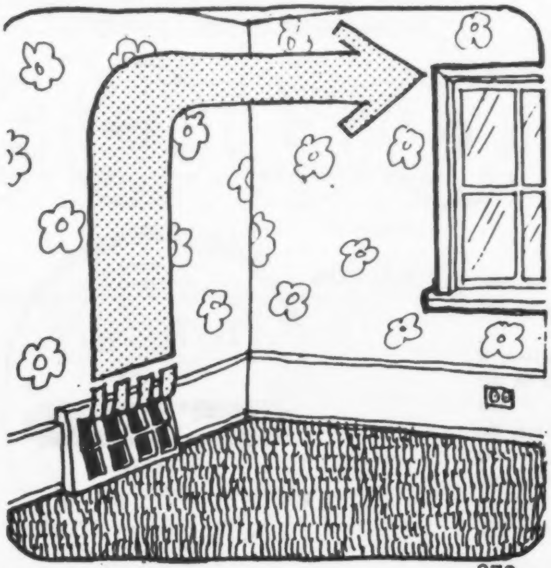
Heat flows via three separate processes:

1) CONDUCTION: Heat can be transferred directly from one part of an object to another part (as when the handle of a cast iron frying pan eventually gets hot). Similarly it can pass from one object to another (as when you try to pick up that frying pan). If one surface of the material is heated, the heat will be conducted through the material to the colder surface. The heat itself actually moves. Some materials, of course, will conduct better than others. Air is a relatively poor conductor of heat, though it does transmit heat by convection and radiation (see below).



2) CONVECTION: Heat can also be transferred by the movement of heated material such as air. In an uninsulated wall space, for instance, air in contact with an inside wall will gradually heat up. Warm air rises, and the air in the wall cavity will begin to circulate. The warm air will come into contact with cold exterior walls, heat them up by conduction, and — bit by bit — heat is lost. At the same time, warm inside air may gradually filter through the wall to the outside — a further heat loss by convection.



3) RADIATION:

Heat loss by radiation occurs when there are two separate bodies or surfaces at different temperatures. The warmer body or surface will radiate heat to the colder body or surface without heating the air between them.

Thus any warm object will radiate heat in exactly the same way that the sun radiates heat — "heat waves" are given off. If you place your hand close to a light bulb, it feels warm — even though there is no air movement. Put a piece of paper between your hand and the light to block the waves, and your hand feels cooler. In an uninsulated wall space, a warm inside wall would radiate heat across the uninsulated space to the cold outer wall. More heat is lost.

Infiltration is warm air escaping to the outside and being replaced with cold outside air. This occurs by way of leaks around doors or windows, through open doors or windows, through cracks in walls, or up a fireplace chimney. Infiltration losses can be considerable.

ENERGY CONSERVATION BULLETIN 4.4.1
Reading And Understanding Utility Bills

2100 West Littleton Blvd **Littleton, Colo 80160**

Next time you receive a utility bill, spend a few minutes with it and make sure you understand what the charges are for. Compare it to bills for the previous month or for the corresponding month of the previous year, and see if your energy consumption has increased or decreased.

EXPLANATION OF TERMS

B.T.U.
The standard unit used in measuring the heat content of fuel. A B.T.U., or British thermal unit, is the amount of heat needed to raise the temperature of 1 pound of water 1° F.

Fuel cost adjustment:
A fee, also called a "pass-through," is added to an electric bill to compensate the company for the increased cost of the coal, gas, oil, or nuclear fuel from which it generates the electricity.

Watt:

The unit used in measuring amounts of electric power.

Kilowatt (KW) is equivalent to 1,000 watts

Kilowatt-hour:

Consumption of electricity is measured by the kilowatt-hour, which is the amount of energy delivered by an hour long flow of 1 kilowatt of electric power. Your electric bill is based on the number of kilowatt-hours you use. (A 100-watt bulb burning for 10 hours will consume 1 kilowatt-hour of electric power—100 watts multiplied by 10 hours equals 1,000 watt-hours or 1 kilowatt-hour.)

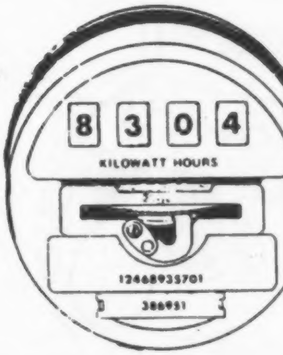
Here's how to read a meter:

Intermountain R.E.A. uses two kinds of meters. One is a digital meter in which numbers appear in little windows. The other is a dial meter, so named because it has dials rather than windows.

With the digital-type meter, simply record the numbers. In Figure 1, the reading would be 8304.

Figure 1:

DIGITAL TYPE

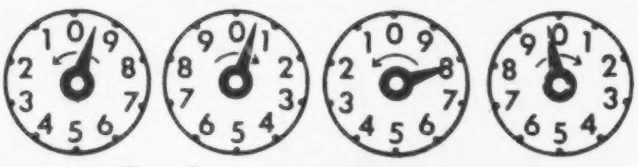


To find how much electricity you have used in the past 24 hours, subtract the previous day's reading from the present reading.

A few meters have a "multiplier" listed on the face. If the number is 1, then the kilowatt-hours used will be the difference between the two meter readings. If the multiplier is higher than 1, use that number to multiply the difference between the two readings to get the kilowatt-hours used. For example, if the difference between yesterday's and today's readings is 3 and the multiplier is 10, then you used 30 kilowatt-hours (3 x 10).

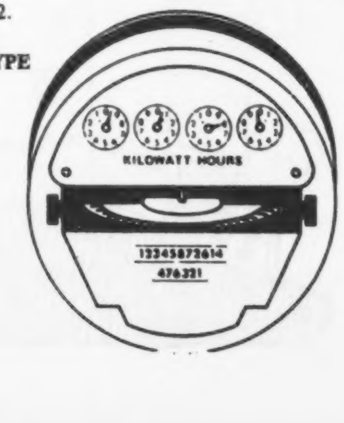
The dial-type meter has several clock-like faces. Read number at which the left hand dial is pointing and write it down. Then read each of the remaining dials and write in those numbers. If an indicator is between numbers record the lower of the two numbers.

Examples: If the indicator is between 9 and 0, the lower number is 9. If the indicator is between 0 and 1, the lower number is 0. If the indicator points directly at a number, you should check to determine whether that number or the next lower one should be recorded. Use the number at which the indicator is pointing if the indicator of the dial to the right is between 0 and 1. However, if the indicator of the dial to the right is between 9 and 0, then record the number below the one at which the indicator is pointing. The meter shown in figure 2 reads 9079.



(Figure 2.

DIAL TYPE



METER MONITOR CHART

END OF
MONTH READING ____________ KWH USAGE ____________
AMOUNT OF BILL ____________
$\frac{\text{AMT}}{\text{KWH}}$ = ¢/KWH (average cost per KWH) ____________

Note: To obtain daily KWH usage, subtract previous day's reading from current day's reading

Daily Reading	KWH Used Daily	KWH Weekly
1		
2		
3		
4		
5		
6		
7		
Weekly total		
8		
9		
10		
11		
12		
13		
14		
Weekly total		
15		
16		
17		
18		
19		
20		
21		
Weekly total		
22		
23		
24		
25		
26		
27		
28		
Weekly total		
29		
30		
31		
Extra Days Total		
MONTHLY TOTAL →		

Monthly Total KWH Usage × Average Cost Per KWH = Estimated Bill
____________ × ____________ = ____________

Budget Cushion ____________
Budget Figure ____________

It's really best to begin your readings on the "meter reading" or the "service to" date noted on your last electric bill. By subtracting the previous day's reading from the current day's reading, you obtain the number of kilowatt-hours (KWH) used during the 24-hour period. By adding the daily figures into a weekly total, and the weeks into a monthly total, you can begin to see how much electricity your family uses monthly and how this usage fluctuates with family activities.

The daily reading may be about the same for several days and then shoot up. When this happens, ask yourself . . . "What was different about that day?" Perhaps it was cooler or hotter than usual, requiring heating or cooling equipment to work harder? Perhaps you had visitors? With more people around, refrigerator doors as well as entry doors are opened and closed more often . . . more lights, food preparation and entertainment appliances are in use.

When your electric meter shows more power being used, there's a reason for it. It's up to the Sherlock Holmes in your family to find it. . .and monitoring the meter gives you the first clues for the search. Once you know your family's electrical-usage patterns, you can then make value judgments as to what conservation practices best fit your lifestyle.

ENERGY CONSERVATION BULLETIN 4.5.1

Why Conserve

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Almost all of us believe to some degree in conservation. For some people, it is a simple matter of saving money; for others, a husbanding of resources now so that we will not find ourselves short in the future. For yet other poeple, conservation represents an ideal, a way of life to which we should aspire. Whichever is your view, there are many sound reasons to support energy conservation as an important new direction for our energy policy. Let us focus briefly on just the most obvious of these.

First, there is the sheer physical volume of energy that is being demanded in a world of ever more people, of higher incomes, and of more technology. With every increase in our rate of consumption, it becomes harder to find, produce and transport the necessary energy materials. For the first time, we are in a position where projected future demands levels cannot be satisfied by conventional energy sources. Without conservation, oil and natural gas shortages may bring the energy situation to a critical stage unless uncertain nonconventional or potential frontier resources are developed and delivered in sufficient quantity — and we can't depend on that. Even future electricity supply is not assured. Feasible hydro sites are now almost totally developed and high quality uranium reserves are limited.

Second, even if we could locate energy resources of suitable quantities and qualities, their costs would be monumental.

This effect gets worse with time because, as we move to lower quality and more remote sources of energy, it will cost us more and more money and energy to obtain energy. The costs continue to rise!

The impact of this on our economy will be severe, both in terms of inflation and because it means fewer dollars for housing, schools, hospitals and industrial projects.

Third, assuming the resources were available and could be produced at a cost that we were willing to pay, to produce them and then consume them would involve large-scale environmental impacts.

Obviously, by conserving energy, the environmental impacts of production, transportation and use of energy can be avoided. Energy conservation can be viewed as the purest form of environmental protection.

In view of the resource and cost factors, conservation offers a low-cost and low-risk alternative to continued high-demand growth.

Finally, let us examine the idea of quality of life. This is perhaps an over-used phrase, but the fact that it is overused means that, for many people there is a feeling that our higher incomes and greater wealth have not been producing all that we had hoped that they would. For example, we now have larger, more powerful automobiles, but it takes us just as long to get to work and there are even more aggravations on route. Our luxurious homes are burgeoning with appliances, our garbage bags burst with waste from the affluent society. But has all this consumption and convenience brought us closer together — or has it alienated us from the natural world and from each other?

There is sound evidence to think that most indications of quality of life have begun to turn downward. We once thought that the "good life" was closely related to our energy consumption. It now seems that efforts at moderating that consumption — smaller cars, more mass transit, better built houses, less waste production, more personal involvement — will contribute to the quality of life at the same time as they save energy.

Home Comfort

— A well insulated house is a comfortable house! In winter, the interior surface of an uninsulated wall can be 4 to 8 Celsius degress (8 to 14F°) cooler than an insulated wall. Most people don't realize that body heat will radiate to the cold walls, ceilings, or floors, at a rate uninfluenced by the room temperature. We feel cold, and may even turn up the thermostat, thereby using even more fuel. Insulation overcomes this "cold wall effect."

—These same cold surfaces will cause drafts. Air adjacent to them will be cooled, and so increase in density. It will settle, displacing warm air. Insulation acts to prevent this. At the same time, weatherstripping and caulking also act to cut down on other drafts.

—During the summer, insulation will keep a house cooler. In effect, the insulation is keeping the heat from the sun out.

— Most forms of insulation also act as sound insulation. Storm windows and doors keep noise out as well.

ENERGY CONSEVATION BULLETIN 4.6.1
Frame House Construction

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The vast majority of houses are referred to as "wood frame" constructions. Put simply, this means that the structural framework is made largely of wood. The exterior may be brickwork, stucco, wood, steel, aluminum, or numerous other finishing materials while the interior will most often be plaster or drywall. Nevertheless, the structural support and strength derives from the wooden frame hidden behind the surfacing. This chapter outlines the basics of this kind of construction.

There are a number of other possible constructions for a house. Solid masonry (brick, stone, or concrete) or solid wood are the most common.

As mentioned, however, wood frame houses are a very substantial majority in this area. Fortunately, they are readily re-insulated.

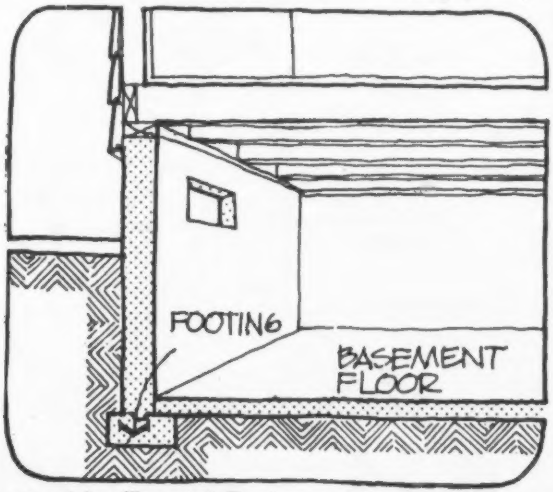
Solid construction houses are more difficult, but not impossible. If you are unsure about how your house is built, there are a couple of ways to get a look into the wall. In many houses, the wall construction can be seen from the attic. If not, it may be necessary to poke a small hole in the wall finish. This should be done in an out-of-the-way place, such as the back of a cupboard. If you damage the vapor barrier make sure you repair it before re-sealing the hole.

It is important to have an understanding of how a typical wood frame house is built. Details will vary from house to house, but the general principles are as follows:

Basement Foundation

Foundations are normally made of concrete, concrete blocks, or stone.

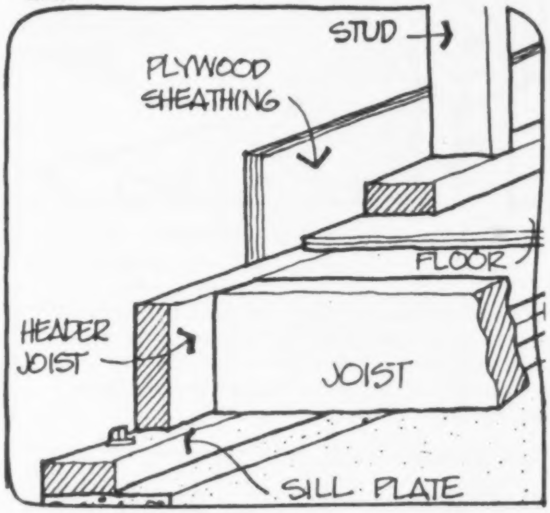
Houses with basements set upon a footing (usually concrete) as illustrated. Few homes of this sort have any basement insulation at all.



Houses without basements most often have a foundation similar in principle. Insulation is often applied against the footing on the outside of the house.

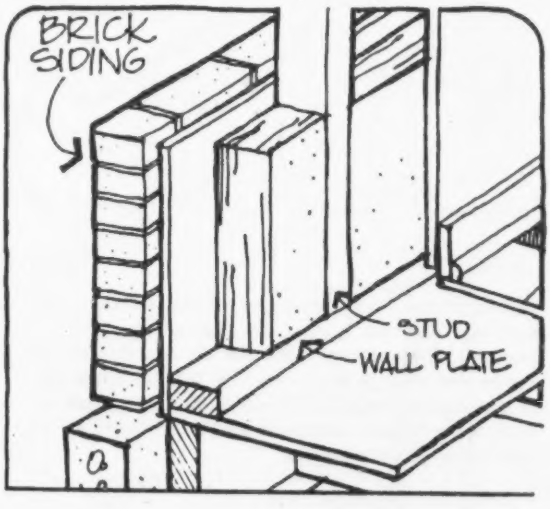
Walls

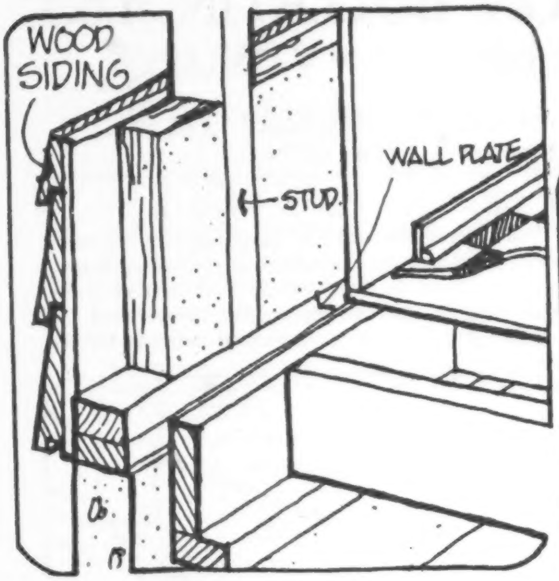
The junction between the foundation and the walls varies greatly, but the diagrams in this section represent a few typical formats. The "sill plate" is anchored to the foundation in order to support the "joists" and the "header joist." These in turn support the walls and the floor.



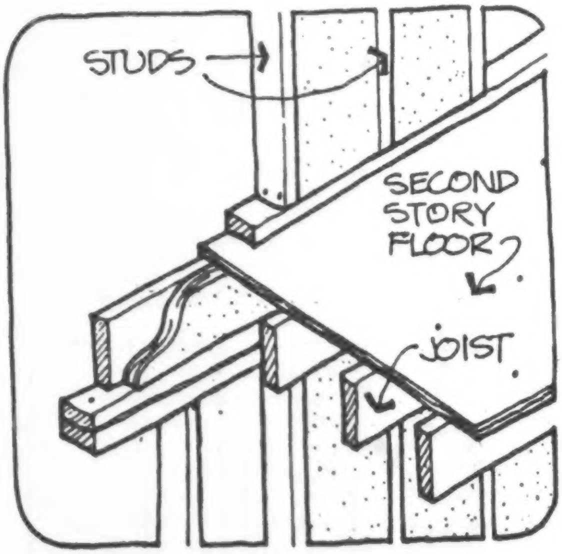
The "wall plate" supports vertical wooden "studs," usually 2" x 4" or 2" x 6". Except in the vicinity of windows and doors, these studs are uniformly spaced, usually 16" or 24" apart. The stud space is where wall insulation is normally placed.

The inside and outside finish is attached to the wood frame in a number of ways, as illustrated. Notice that in each case the finish, though protecting the structural parts of the wall from the elements, contributes only slightly to the strength of the structure.




WOOD SIDING
WALL PLATE
STUD

In most 2-story homes, the junction between 1st and 2nd floors is constructed as in the diagram. Of necessity, insulation should be applied in the 3 spaces indicated: the 1st floor walls, the 2nd floor walls, and the space between the 2 floors.

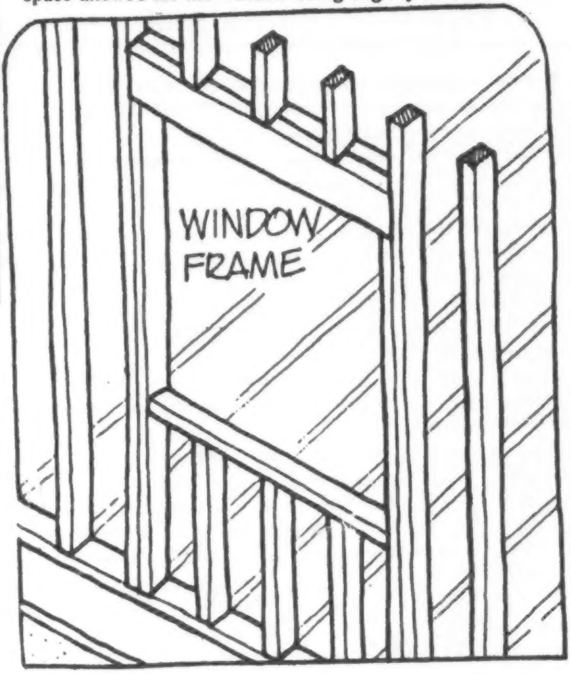

STUDS
SECOND STORY FLOOR
JOIST

Some walls in 2-story houses are constructed differently, such that the stud space runs continuously from the foundation to the attic. In such a case the insulation should also be continous. In other instances, the stud space may be broken up at irregular intervals by wooded crosspieces (used as fire-breaks). Insulation must be applied in all the stud spaces that this creates.

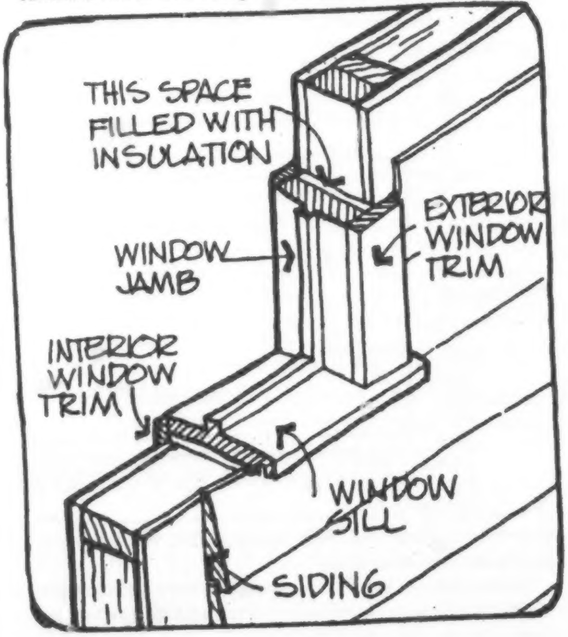
4.6.2

Windows and Doors

Around windows and doors, the stud space may become irregular. Framing is generally done as shown, with the space allowed for the window being slightly oversize.


WINDOW FRAME

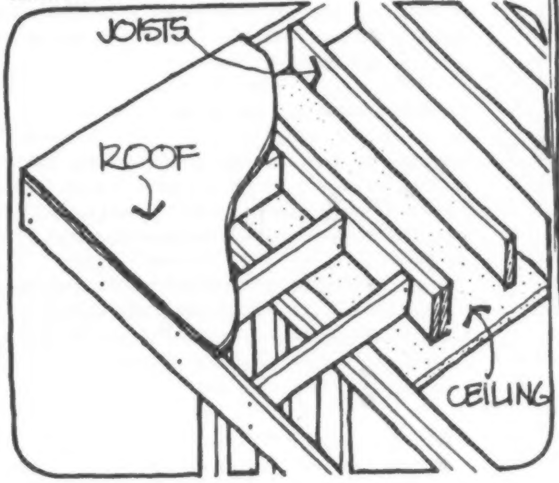
Precise fitting is then achieved using small pieces of wood (spacers) to position the actual window frame. Insulation must still be applied to the irregular stud spaces, as well as to the tiny openings around the door or window which result from the framing. These thin spaces cannot be insulated except when the wall is being built.


THIS SPACE FILLED WITH INSULATION
EXTERIOR WINDOW TRIM
WINDOW JAMB
INTERIOR WINDOW TRIM
WINDOW SILL
SIDING

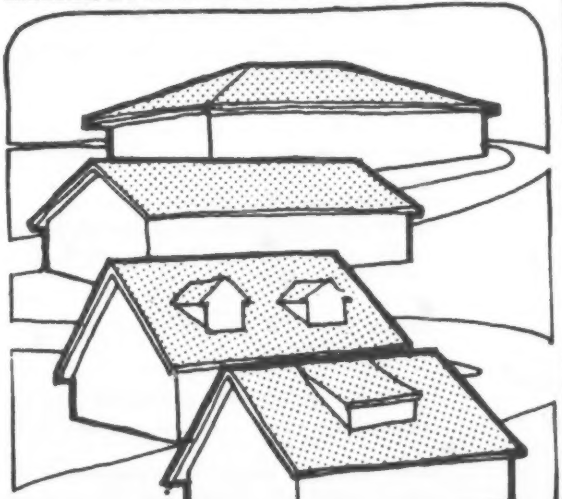
4.6.3

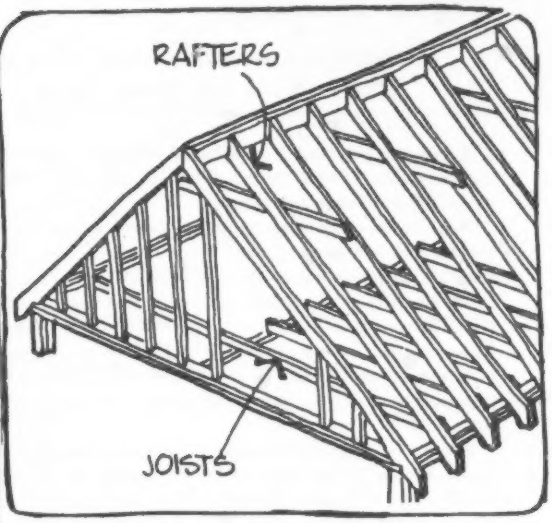
Ceiling and Roof

Flat roof homes are commonly constructed as illustrated, with both the ceiling and roof attached to opposite sides of the same joist. Insulation may be applied between the roof and ceiling, or on top of the entire construction.

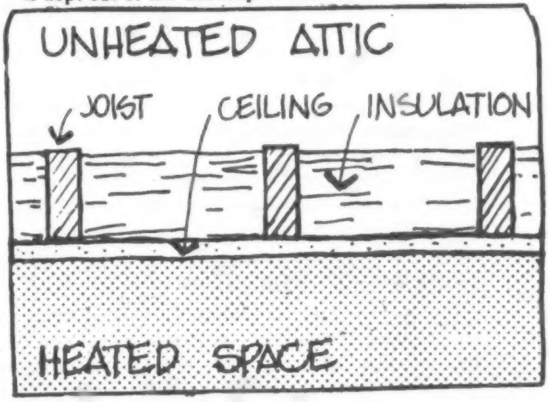

JOISTS
ROOF
CEILING

The more common styles with sloping roofs (a few are illustrated) are framed somewhat differently. The ceiling material is attached to the lower joists, while the "rafters" support the roofing material.

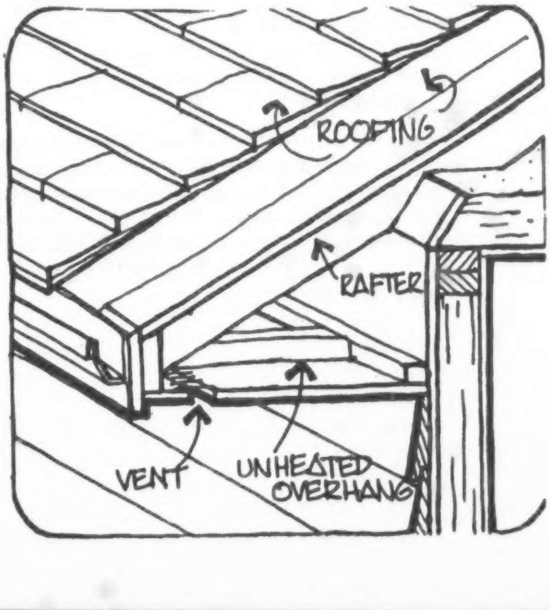



RAFTERS
JOISTS

The insulation is laid between the joists, so that the heat is kept out of the unoccupied attic.


UNHEATED ATTIC
JOIST
CEILING
INSULATION
HEATED SPACE

The rafters usually extend beyond the exterior wall of the house, leaving an unheated, uninsulated overhang space.


ROOFING
RAFTER
VENT
UNHEATED OVERHANG

ENERGY CONSERVATION BULLETIN 5.1.1

New Homes

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If you are planning a new home, you can add to its comfort and enhance its salability, even while saving considerable energy and money.

By investing in a few energysaving features, you can cut the heating and cooling costs to well below those for a comparable house built to the standards of 1974 or earlier.

Usually when you build, you intend to stay awhile. (Even if you plan to move, an energy efficient home should be worth more.) Savings of $300 to $500 a year in energy bills mount up quickly and you can recoup the extra expense in a few years. After that, you are ahead financially.

Energy savings can be made through the design of the house and by taking care in its orientation on its site. South-facing windows can be solar collectors in winter and can be shielded from the sun in summer by an overhang that varies in width with latitude. On other sides, windows should be held to the minimum size needed for daylight (an energy saver) and for views.

Savings can be made by locating living areas on the south and east sides, bedrooms on the north. Doors can be insulated and have automatically closing storm doors. For frequently used doors, vestibules are an old idea whose time has come back.

Positioning the house to counteract or take advantage of prevailing winds is another of the many complex functional factors that must be fitted together in designing an energy efficient home. Combining these with an attractive result is a job for an architect.

If you can find an energy-oriented architect, his contributions and supervision can be worth much more than his fee. However, many architects today may be challenged to satisfy a client who makes a strong demand for an energy-efficient home.

An interesting idea worth looking into is the passive solar home. One kind has no solar panels. The structure takes maximum advantage of solar orientation for heat gain in winter and removes any excess daytime heat and stores it in a slab or sand bed under the house, from which it radiates upward. A heat pump provides basic heating and air conditioning.

Another idea: Instead of the usual 2-by-4-inch studs, use 2-by-6-inch ones. That will allow 5½ inches of insulation in the walls. Add an inch of rigid plastic insulation under the siding and you achieve better than R-19, now recommended for walls in practically all of the U.S.

The use of 2-by-6-inch studs entails little or no extra lumber expense since they are set 24 inches apart instead of 16 inches. The added insulation is worth the cost. If necessary, you can afford the insulation by postponing the purchase of something else.

Comfort systems for a new house

Selecting the kind and capacity of heating and cooling systems for a new or remodeled house is a job for experts. All of your energy-saving features should be factored into the calculations to give you the least capacity that will do the job.

If you don't have an architect to do this, choose a contractor who will make a detailed analysis of your needs, or one who has access to a manufacturer's computer for an analysis of your specifications, climate, energy prices in your area and other conditions.

- Consider a square floor plan.
  It usually is more energy efficient than a rectangular plan.

- Insulate walls and roof to the highest specifications recommended for your area.

- Insulate floors, too, especially those over crawl spaces, cold basements, and garages.

- Install windows you can open so you can use natural or fanforced ventialtion in moderate weather.

- Use double-pane glass throughout the house. Windows with doublepane heat-reflecting or heat-absorbing glass provide additional energy savings, especially in south and west exposures.

- Consider solar heat gain when you plan your window locations.

  In cool climates, install fewer windows in the north wall because there's little solar heat gain there in winter.

- Install louvered panels or windpowered roof ventilators rather than motor-driven fans to ventilate the attic. Only use a motor-driven fan if it can be used for wholehouse ventilating during cool periods.

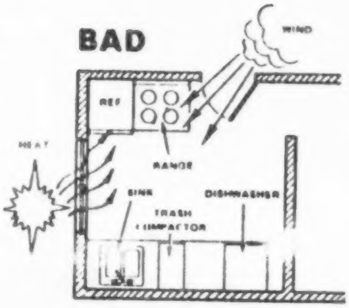
Kitchen Layout

When improving or remodeling a kitchen, built-in energy conserving measures may substantially reduce the amount of energy needed to operate appliances and may even represent an investment with long term savings in operating costs.

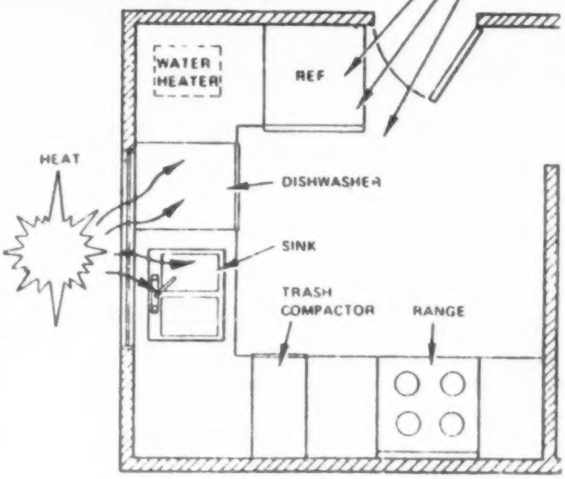
According to experts, consider carefully the best location for each appliance. Kitchen appliances are commonly grouped according to the function they will serve. If possible, three separate areas should be established for food storage, preparation and clean up, and cooking.

Install the refrigerator-freezer and separate freezer away from windows, radiators and heat producing appliances. Locate refrigeration appliances in a level, dry, cool, well-ventilated area. Make certain there is a level, dry, space behind and above the units to allow adequate air circulation to the condenser. Refrigerator condensers are located either directly behind or underneath the units. More space should be allowed behind the unit if the refrigerator has a back-mounted condenser.

Locate the range in an area away from refrigeration equipment where a vent fan can be installed to draw excess heat directly to the outside in the summer. To minimize room heat loss in the winter and heat gains in the summer, check your kitchen for air leaks. Weather strip and insulate windows and doors. For example, a gap of ¼ inch at the base of a normal 36 inch wide door equals a 9 square inch hole in the side of your house.



BAD



GOOD

If You Buy An Existing Home

Few homes built even in recent years have insulation that meets today's requirements. Before you buy a house, you should try to assure yourself that it has at least a minimum. Some sellers won't know what's in their house; others will avoid a commitment, especially in writing. A few will be able to produce bills for insulation or show you what's in the attic.

The bottom line is in the actual fuel energy bills for the house over the past year — not selected months.

Ask to see the utility bills from the previous year but remember to adjust them for current utility rates.

You can see whether the house has double glazing or storm windows, tell generally how well its doors and windows are weatherstripped and if cracks are caulked. Even some new houses don't have insulation in the exterior walls. Be sure to check. But adding insulation and storm windows could be substantial outlays. If improvements are necessary, you may want to seek an adjustment in the purchase price to cover all, or a reasonable share, of the costs.

If you are not knowledgeable about building details, then it might be wise to have an architect or heating and air conditioning contractor look at the house before you make a final decision. He will evaluate a lot more for you than its energy performance.

best copy available

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APPENDIX M

THE TVA EXPERIENCE

by James W. Ward, Assistant Director
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Based on size alone, our Home Insulation Program is unique, for TVA operates the largest electric power system in the country. Working through 160 local distributors, the Agency's FY 1978 power sales to ultimate consumers were more than 113 billion kilowatthours. Of this, the TVA system supplied 2.4 million residential consumers with about 38 billion kilowatthours of electric energy.

That's a lot of electricity and, to us, represents a tremendous but challenging energy conservation opportunity. But, as you may very well know, challenging tasks have been the bread and butter of TVA since its inception. For 46 years, the Agency has gathered experience in the development and wisest use of our natural resources. And with the people of the Valley, we have tamed a river and brought economical growth to a depressed area. In that perspective, the large-scale residential conservation program we are charting is just one more frontier for us to explore.

Today, our Home Insulation Program—conducted in cooperation with our power distributors—seeks to achieve energy conservation and the more efficient use of electricity for all our residential consumers. To get the job done, the program features free home energy surveys for anyone who asks for it, no-interest loans for a variety of weatherization measures, and low-interest financing for the installation of electric heat pumps in qualifying single-family detached homes or duplexes.

As planned, the Home Insulation Program will account for an annual energy savings of 2.7 billion kilowatthours by 1986. It will produce a consumer benefit of $81 million a year, and save about 1,100 megawatts of peak demand for the system. Further, the Agency will meet these goals at a benefit-to-cost ratio of about 4 to 1.

The program's current features and the directness of the program's goals do not, however, reflect the many stages of the program's development. Before we were able to barrel full steam ahead, we first had to crawl, then walk.

Initially, the Agency had to meet two basic requirements before the residential energy conservation program could move forward. First, the program had to produce a positive benefit-to-cost ratio for the power system since the system's operations are self-supporting. Second, the program had to provide a net benefit to all residential consumers since discrimination between consumers in the same class is prohibited by the TVA charter.

We met these requirements through experience and data gathered in a small-scale program demonstration. The demonstration allowed us to gain the necessary financial data and experience to project the positive benefit-to-cost ratio and to determine the most cost-effective insulation levels and weatherization measures for the program. From this, we started a program that featured the largest single energy-saving measure we could offer—no-interest loans for attic insulation.

As approved by the TVA Board in March 1977, the Home Insulation Program provided free energy surveys for any residential consumer who asked for it and interest-free financing for attic insulation for electric heating customers. A short time later, additional data and experience allowed us to amend the program so that electric cooling customers could also secure no-interest loans for attic insulation.

Then, almost a year later, we amended the program once more. This expansion provided interest-free financing for a variety of weatherization measures in addition to the previously offered attic insulation. By September 1978 interest-free loans were available for attic and floor insulation, storm windows, insulated doors, caulking, and weatherstripping in electrically heated homes. For electrically cooled homes we were able to justify the financing of attic insulation, insulated doors, caulking, and weatherstripping.

This year, still another feature was added to the program. We called it the Heat Pump Financing Plan. Under this option, the Agency provides low-interest loans for the purchase and installation of an electric heat pump system to replace an existing electric system where cost effective.

Now, the specifics of our residential energy audit program. I will begin with the selection and training of our energy advisors. Then I will run through the actual survey process to include the survey and survey forms, contractor installations, reinspection procedures, payback scheduling, quality control measure operating within the program, and storage and retrieval of survey information by computer. For clarity, the

Heat Pump Financing Plan will be explained separately. And finally, I will bring you up to date on the program's operations.

At the very heart of TVA's Home Insulation Program are the energy advisors trained by the Agency. The advisors are the eyes and ears of the program and represent our most effective program advertising. If they have an unsatisfied consumer, that displeasure is shared by the consumer with his friends and neighbors. If a consumer is helped, the consumer spreads the word down the block and around the corner.

Although most all of the energy advisors now working in the program have 4-year college degrees, the program's minimum education requirement is a 2-year degree from a junior college, vocational or trades school, or the equivalent job-related experience. We seek advisors with a strong math and physics background, and we want advisors with a demonstrated ability to work well with others. For the bottom line is this—with a minimum of supervision—the advisors must be able to inspect and then ably recommend to a consumer the most cost-effective measures a consumer can take to save energy and money. And, the advisors must be able, and more than willing, to carefully explain the program's features and to answer any question a consumer might have.

Although the job is demanding, we have been able to select advisors from a large pool of applicants. And, those we select, we pay well. Starting salaries for our advisors are now at $10,355. If within six months an advisor's work is acceptable, the advisor is raised to $11,835. And within 18 months, an advisor can be making $13,910, plus fringe benefits.

The training course for the energy advisors is four weeks regardless if the advisor is hired by TVA, or as an employee of the power distributor. (Right now we have 166 TVA advisors and 75 distributor advisors.) The advisors have two weeks of classroom study to learn such things as resistance values, the calculation of heat loss, and program features. Classroom materials and instruction are provided primarily by the power use specialist on our staff. Then for two more weeks, the advisors receive supervised field training, gaining on-the-job experience. Of course, throughout their working careers, advisors also receive additional training and instruction.

To obtain the services of our highly qualified and well-trained energy advisors, a consumer just has to ask for a free home energy survey. The survey request may be made by phone or by mail to either TVA or the consumer's local power distributor.

Once a request is received, the consumer is notified by mail when to expect a survey. And the consumer is told that an energy advisor will be contacting them to set up a specific time for the survey. Right now the consumer must wait from four to six weeks to obtain a survey because of the request backlog.

At an agreed time an energy advisor working out of a TVA district office or a distributor office or location, will arrive at a consumer's dwelling to conduct a survey. A dwelling may be a home, apartment, or mobile home. A consumer may be a homeowner or a renter. It doesn't matter.

The point of a home energy survey is to identify ways the consumer may reduce the energy waste and loss in his or her particular dwelling.

In the dwelling's attic, the advisors check the level of insulation, the amount of ventilation, and to see if the dwelling's exhaust vents and recessed lighting are clear of insulation and debris. The advisors also look for moisture problems and any electrical hazard. Often, our advisors are the only people, other than the builder, that has been in a consumer's attic. Therefore, the advisors try to give the consumer a good picture of what is there or what isn't.

The advisors are equally thorough in inspecting a dwelling's crawl space. It is a dirty, grimy job, but again it may be the only look a consumer has of the home's weatherization measures.

Advisors request the square footage of a home, but they also take their own measurements. The types of windows and doors are noted by the advisors, as is the actual size of the openings. Advisors check for caulking and weatherstripping, and the condition of it.

Ductwork, if present, is also examined by the advisors, as is the amount of wall insulation, and the temperature level at which the water heater is set. Advisors also note the type or types of heating and cooling available to the dwelling. And although a home energy survey takes about 1-1/2 hours on the average, energy advisors will spend whatever time is necessary to insure that a consumer's home is completely inspected.

Once the formal inspection is completed, advisors make the necessary recommendations to help make the home more energy efficient. In this recommendation levels of insulation are determined, as is the need for storm windows, insulated doors, ventilation, caulking, and weatherstripping. Advisors make a rough cost estimate of the all-needed weatherization work, provide the consumers with a list of contractors using TVA-approved materials, explain the no-interest loan offering, inform the consumer of the survey findings, and provide any additional information the consumer might need. If at the completion of this, the consumer wishes to take advantage of the no-interest loan, advisors complete the necessary work participation forms and contractor specification forms.

About 40 percent of the consumers requesting a survey also request a loan. Of those consumers who do not exercise the no-interest loan option, approximately 44 percent complete part, or all, of the recommended weatherization work.

If a consumer has a contractor performing the weatherization work and the consumer is participating in the loan program, an energy advisor will return to the home when the work is completed to inspect the contractor's work. A contractor must pass the energy advisor's reinspection before monies are released for payment of the work.

In a reinspection, the advisor makes sure that the recommendations have been met by the contractor. And he will see that the work is done properly. For example, the advisor will ensure that insulation is properly placed, with no gaps in the insulation. The advisor will see that adequate ventilation is provided and that exhaust vents, recessed lighting, and the like are not covered by insulation.

When the reinspection is completed and the loan is approved, the consumer signs an agreement to pay the loan back in equal payments on his electric bills over a period up to seven years. Presently, loans are averaging about $1,000. The maximum loan allowed is $2,000. Over the payback period, the loan will pay for itself through savings on the electric bill because the consumer is using less electricity for heating and cooling. Of course, once the loan is repaid, the consumer can enjoy the energy and money savings for the lifetime of the home.

For example, a Belmont, Mississippi, consumer, with no insulation in his 1077-square-foot attic, spent $236 to get the recommended R-19 level of insulation. He saved $182 the first year on heat alone, and it will take him just 1-1/4 years to recapture his initial investment.

In another Mississippi home, a consumer insulated her 810-square-foot attic at a cost of $187. In one year, she saved $124 on heating cost, giving her a payback in less than 1-1/2 years.

At the end of July, about $20 million had been loaned by TVA to more than 61,000 power consumers for weatherization work. Of those loans, only 20 have been deemend uncollectable. Or put another way, out of that $20 million, less than $7,000 loan dollars have been defaulted.

Because of the sheer size of the program, the amount of money being loaned in the program, plus survey specification sheets and the like, a large number of forms are required for the program. We have forms that contain the actual survey information, and a tenant and landlord agreement to participate in the loan program.

One series of forms contains the specification and work completion information for the contractors. Another contains the actual repayment agreement with the consumers and gives the total amount of the loan, in addition to the amount and number of monthly payments.

One form serves as protection for the Agency. If a homeowner has attic insulation installed but does not have the recommended ventilation added, we ask that he sign a particular form to release us from possible damage claims. Without adequate ventilation, moisture problems can develop that could destroy the effectiveness of the insulation, and create other building problems such as rotting timbers.

Information from the forms, except the consumer's name, is fed into computers for storage and retrieval. Although the computer system reduces manpower need, considerable manpower is still required to process and file the forms.

The computer enables us to call up data for analysis and monitor the effectiveness of the program. We can know quickly such things as the amount of funding distributed, the average size of the homes surveyed, and average cost estimates for doing recommended retrofits.

Initially, information from our surveys could not be keyed directly to the computer. Now it can be, and I recommend that those of you beginning a similar-type program do this at the onset. I also suggest that you plan for adequate administrative personnel to handle the form collection, proofing, filing, and so forth.

This program and others like it require a large amount of paperwork to run smoothly. But programs of this nature also require adequate quality control measures to operate successfully. Let me briefly hit the high points of ours.

Initially, quality control in TVA's Home Insulation Program is maintained through the excellent training of the energy advisors. There are home energy problems in our service area, and the energy advisors are trained to find them all. Also, the advisors are trained to inspect a contractor's work.

Of course, materials used by the contractors, and by the homeowners in do-it-yourself projects, must meet certain specifications. This is a primary quality control measure. In TVA's Home Insulation Program, we set the performance specifications we desired for all weatherization materials included in the program. Any "old thing" won't just do. We worked with manufacturers and got this point across. They were more than willing to work with us.

For further quality control, we conduct an ongoing inspection of new weatherization materials being developed and standard materials being improved. An improved product that checks out against independent laboratory testing is added to our approved materials list. Conversely, a product no longer being manufactured to our required specifications is removed from the list of approved materials.

Additionally, to insure the field use of quality materials, we routinely send samples to an independent laboratory for testing. It is better to be safe than sorry. Too much time and effort can go down the drain if inadequate materials are being used in your program.

Materials, of course, cannot perform effectively if improperly installed. Consequently, to ensure quality installation of weatherization materials, we conduct training seminars and workshops and work closely with the contractors in the Seven-State Valley region.

Besides the obvious benefits, this training and information-sharing with contractors pays off in other ways. For example, training and experience have lowered the call-back rate following an energy advisor's reinspection. Doing the job right the first time saves you and the contractor money.

I've saved the Home Insulation Program Heat Pump Financing Plan option for last. Not because it is least, but because it is our newest program feature and contains a few different wrinkles.

As a supplement to the Home Insulation Program, 85 of the 160 local power distributors have already chosen to offer low-interest loans to home consumers for replacing existing electric heating systems with the electric heat pump. We expect more distributors will join later as new ones agree to participate each week.

To obtain a TVA-financed electric heat pump loan, a consumer in a participating power distributor's area must first request a free home energy survey and then agree to carry out the weatherization measures recommended by the survey.

Once that work is completed or near completion, a trained HEAT PUMP ADVISOR (different from an energy advisor) will help the consumer to decide if an electric heat pump system is cost effective for the home.

If the system is cost effective, the heat pump advisor will leave bid forms with the homeowner outlining the specifics of a particular job. The homeowner, choosing from a list of contractors or dealers participating in the program, solicit bids for the work. Once the work is completed and approved, the heat pump advisors authorize the power distributors to pay the dealer or contractor.

The homeowner or the landlord signs the payback agreement and the loan information statements.

Consumers exercising the Heat Pump Financing Plan option have up to 10 years to repay the low-interest loans. Payments are added to the monthly electric bill.

The interest rate for the loans is at the same rate that TVA must pay when the Agency borrows money. Right now it is averaging 8-1/2 percent. The loan rate does remain fixed once the agreement is signed.

Estimates, based on a fully insulated 1500-square-foot home, show that a consumer can save from 4,000 to 7,000 kilowatthours during a heating season. This translates to a savings of $130 to $230 on electric bills.

We have estimated that this one loan program will cost $5.9 million over the next eight years, but will save $12 million through reduced energy supply cost for the TVA power system.

As of July 30, 746 heat pump surveys had been completed by the specially trained 27 heat pump advisors. From these surveys, 156 loans were made, and approximately 600,619 kilowatthours saved. The present request backlog stands at about 900.

In the weatherization portion of the Home Insulation Program, almost 135,000 home energy surveys have been completed. And, more than 61,000 loans have been made. The estimated annual kilowatthour savings are about 152 million.

Where did these 152 million kilowatthours of savings come from? Let me illustrate by giving you the savings that can occur when a 1380-square-foot home that is heated and cooled electrically receives needed weatherization measures. All figures are based on 3,500 degree days, 1,000 cooling hours. Electricity cost is based on three cents a kilowatthour.

Before the home was weatherized, existing conditions were: infiltration of 1.5 air changes per hour, R-6 ceiling insulation, no floor insulation, single glass windows, and a poor wooden door. The electricity use was 19,945 kWh, at a cost of $598.

After weatherization measures were added, electricity use was reduced by 10,083 kWh for a savings of $302. Infiltration rate was reduced to .75 changes per hour, saving 2,090 kWh. Ceiling and floor insulation increased to R-19, saving 4,811 kWh. Storm windows were added—2,136 kWh saved—and a metal insulated door replaced the wooden door, saving another 403 kWh.

In closing, I would like to suggest that TVA's Home Insulation Program and other similar programs are workable energy conservation plans that can significantly benefit a power system and its consumers. They are "can do" programs meeting the critical national need to conserve energy.

If you are just now deciding if a residential energy audit program should be offered by your system, let me urge you to consider it. Start working towards one today. With more and more of our energy resources being stretched to the limit, today is none too soon for conserving energy where we can.

CITY UTILITIES OF SPRINGFIELD, MISSOURI

Conservation Audit Problem Areas

December 14, 1978

City Utilities energy audit program has been in operation now about one year. In this time we started with just about zero knowledge of energy audits and have worked our way to the point where we can now provide what we consider a fairly adequate home audit and infrared thermal audit. We have been confronted with many problems although none have been considered major.

Residential Home Audits

Originally we did not know what customer demand to expect; therefore we didn't know how many people to hire to perform home audits. We do have two full-time personnel and also one full-time infrared camera operator. To conduct home audits, it was our decision to go with part-time people. We had fair success hiring college students to work as the need arose. To date we have seven home auditors, all part-time. We have had some retired people who enjoy this type of work. To date we have conducted 825 home audits and 500 infrared camera audits. The 825 homes audited is 1.5 percent of the homes in our service area. Our problems can be summarized as follows:

1) Personnel problems. It has been difficult to find enough auditors.
2) Equipment problems. Only minor; we have had minor downtime on our thermovision camera.
3) Unknown customer demand for this new service.
4) Is our program getting through to our customers? Feedback is very difficult to measure.
5) Program acceptance. Are our customers really taking corrective action after our audits?
6) In the initial stages, our own program implementation problems:
    What to do?
    How to do it?
    Which form do we use?
    What do we want the audit return to show?

After the audit forms were decided upon and the results were formatted in a suitable style, the biggest problems that we faced were simple things, such as setting up appointments with those customers that requested audits. We spent a lot of time trying to reach customers setting up both the initial audit and the audit return.

Infrared Audits

Our thermo-vision infrared program has been, what I consider, successful. Our biggest problem has been finding a willing operator, one who didn't mind outside work, midnight to sunrise. We now have a very good operator.

During our first winter of operation, January through March, 1978, we conducted over 400 thermal audits. We did a lot of experimenting to determine how many pictures to take and how much detail was needed. We now have a special rig built on the driver's side of a van and the operator can take all necessary pictures from the street. We do not survey the rear of a house unless a customer requests it. We have found that we can do three to four times more by not doing the rear.

Insulation Contractors

We have had continuing minor problems with insulation contractors. In the beginning we didn't make any of them happy with our approved contractors' list. An initial meeting was held to explain what we were doing; this certainly helped. To qualify for the approved list we asked the contractors to prequalify by completing a questionnaire. Most of the contractors did prequalify; some brand new ones did not, mainly because they did not have the minimum required number of finished attic insulation jobs that we could field check. In our area we found only minimal poor quality jobs. Our biggest problem concerned the type of material the contractor could install. We do not field-verify any material by testing. We approve various types of insulation, but the largest problem by far is with the cellulose type. Our requirement is that the material meets federal standards, and we also require testing verification of cellulose quality by an independent laboratory.

PACIFIC POWER & LIGHT CONSERVATION FINANCING PROGRAM

"Operation Insulation"

Program initiated in 1978 in Oregon; also approved by utility regulatory commissions in Washington, Idaho, and Montana. Initial Oregon PUC order allows Pacific Power & Light (PP&L) to expend up to $30 million.

PP&L provides zero-interest financing to residential electric heat customers (one and two-family residences) for cost-effective weatherization programs. Loans are repayable at the time the home is sold or title to residence is transferred. In the case of homes not owned by individuals (trusts or corporations), loan is repaid in seven years.

Conservation measures eligible for zero-interest financing include: ceiling insulation (R-38) with proper ventilation; floor insulation over unheated spaces (R-19); ground covers for crawl spaces; wrapping of water pipes in unheated spaces; storm doors and windows; weatherstripping and caulking; duct wrapping; and timed thermostats on forced air systems.

There is no upper limit on the size of the loans; average loan is $1,354. Size of loan is dependent on whether measures are cost-effective in residence.

A residential customer must have a satisfactory record of bill payment to company (6 months or more) and an acceptable Retail Credit Association report.

Basic program services:

- Homeowner requests PP&L, in writing, to conduct Home Energy Analysis of residence.
- If Home Energy Analysis indicates that any conservation measures satisfy cost-effectiveness test, homeowner is notified and asked if he/she wishes an interest-free loan.
- Contractor-installers bid (written estimates) on job.
- Owner signs contract with PP&L for approved conservation measures and materials based on lowest acceptable bid.
- PP&L inspects all completed jobs and arranges for any necessary follow-up work.
- PP&L insulates all electric water heaters located in unheated spaces at no cost to homeowner.

Contractor selection process:

- Each job is open for bids by contractors—an open bid file is maintained in utility office.
- Residential customer may have a contractor of his/her choice bid.
- In addition, two randomly selected contractors from utility's list of contractors (90-110 State-wide) are asked to bid.
- To participate a contractor must be registered with Oregon's Builder's Board, bonded, insured, and willing to warrant materials and workmanship.

Between August 1978 and April 1979, 7801 persons had requested and received no-interest loans as compared to 216 persons participating in PP&L's 6.5 percent interest loan program which was initiated in 1977.

Cost-effectiveness test:

- The cost of developed energy (or the cost of energy saved) plus the average current customer cost for energy generated must be less than the long-range incremental cost (LRIC) for space-heating (or the cost of additional new facilities for residential space-heating requirements).
- In Oregon, PP&L estimates its LRIC is 42 mills/kWh and its average current customer charge is 23 mills/kWh. Since the current cost of "Operation Insulation" is 15 mills/kWh, the program is cost-effective. The break-even point is about 18 mills/kWh. At this cost, even the nonparticipant customer benefits since the rate per kWh is less than it would have been otherwise.

Treatment of costs:

- The cost of installing conservation measures is included in the rate base until the loan is repaid. The conservation measure investment is not reduced by depreciation expense while it is being carried in the rate base.

- All other program costs (audits, administrative overhead, etc.) are treated as an operating expense and amortized over a 10 year period.

In Oregon it was determined that interest-free loans were not cost-effective for gas customers. The average current customer charge is priced at LRIC or higher.

Conservation Economics

The attached table has been prepared to demonstrate the extreme sensitivity of utility conservation program economics to the interrelationship of three costs: (1) the program cost of the customer "conserved" energy to the utility and all its ratepayers based on the particular financing arrangements of the program; (2) the utility's long run incremental cost (revenue requirement) pertaining to additional generation of energy and capacity comparable to that being conserved through the program; and (3) present charges being paid by customers for capacity and energy based on the Company's embedded costs which represent savings to program participants.

Case A represents Pacific Power & Light Company's present situation: i.e. relatively low embedded costs (line 3); costs of new generation (line 2) presently in the Company's capital budget and planning programs approximately double embedded costs; and an opportunity to recapture energy through retrofitting cost-effective insulation into customers' dwellings at a program cost (line 1) approximately one-third those of new plant generation. On a total systemwide basis the Company's embedded residential electric heat saturation is approximately 37 percent and in Oregon, its major jurisdiction, the saturation is 42 percent. The Company's system peak occurs in the winter.

Case B represents a utility with higher embedded costs (thermal as contrasted with Pacific's hydro) but costs of new generation and energy developed through conservation precisely the same. But the small change in line 3 (embedded cost) clearly makes an interest-free loan program such as being implemented by Pacific not cost justified from the standpoint of the utility and its ratepayers, even though it is in society's best interest to develop kilowatt hours through conservation when their cost is less than that of new generation.

Case C represents an electric utility whose marginal costs (LRIC) are the same as Case A and B but whose embedded costs are higher and who also has customers or a climatic situation such that conservation options have a relatively low benefit/cost ratio. Given such a situation, Pacific's zero-interest loan program is clearly not cost effective for the utility or society generally.

Case D is merely an extension of Case C wherein even the participating individual customer finds the interest-free loan program not cost effective relative to his making the conservation investment.

The principal point of the attached table is to indicate that it is inappropriate to assume that a zero-interest conservation loan program as presently being implemented by Pacific Power & Light Company is economic or in the best interest of the ratepayers of all or any particular utility. A particular utility's resource economics, both embedded and marginal, must be quantified and related to the cost of viable customer conservation options in order to determine the cost effectiveness of not only a program similar to Pacific's, but any loan or customer conservation financing program.

PACIFIC POWER & LIGHT COMPANY

"Zero-Interest Loan" Electric Energy Conservation Program

Simplified Examples of Economic Justification/Non-Justification

	Line	Case A (PP&L)	Case B	Case C	Case D
Cost to Ratepayers of Program "Conserved" KWH (Mills)	1	15	15	50	50
Cost of New Generation KWH(Mills)	2	45	45	45	45
Present Rate Schedule Charge for Additional KWH (Mills)	3	25	35	50	40
Revenue Deficiency in serving additional load through construction of new generation (Line 2 minus Line 3)		45 -25 20	45 -35 10	45 -50 - 5	45 -40 5
Revenue Deficiency in serving additional load if KWH developed through conservation program (Line 1 plus Line 3 minus Line 3)		15 +25 40 -25 15	15 +35 50 -35 15	50 +50 100 -50 50	50 +40 90 -40 50
Is Program Cost Effective for:					
1) Participating Customer?		Yes	Yes	Perhaps	No
2) All Company Ratepayers?		Yes(15<20)	No(15>10)	No(50>-5)	No(50> 5)
3) Total Society?		Yes	Yes	No(50>45)	No(50>45)

July, 1979

PALO ALTO MUNICIPAL UTILITIES, CALIFORNIA

Methodology Used To Develop a Residential Energy Conservation Program

Summary

The Palo Alto Weatherization Program has been designed to achieve the long-range goal of upgrading existing Palo Alto residences to approach today's state standards for energy efficiency in new construction. Achieving this goal requires a program that actively promotes and financially supports the cost-effective, but capital-intensive energy conservation modifications which can be made. The program accomplishes this by providing residents with positive incentives to "retrofit" their homes. These incentives are in the form of a utility service which includes:

- A comprehensive home energy conservation survey available to all residential customers which will concentrate on identifying energy inefficiencies in the home and cost-effective means of correcting them.
- Do-it-yourself information packets covering home energy conservation measures such as insulation, weatherstripping, water heater insulation, duct insulation, caulking, and summer shut-off and fall relighting of the furnace pilot light (for gas furnaces).
- A ceiling insulation option which provides a quality-assured insulation installation by local contractors with eight percent municipal utility financing and payback through the utility billing system.
- Certification of completed insulation installations which meet City criteria for safety and quality.

The State Energy Commission through NCPA partially funded Palo Alto's program by providing $20,000 in grant monies which was allocated in the following manner: $14,000 was used to pay the salaries of two part-time energy surveyors (Home Energy Consultants or HECs), and $6,000 was allocated to cover program start-up costs. These costs included travel expenses, training, miscellaneous operating costs (flashlights, uniforms, etc.).

Money was already budgeted by the City for the salaries of the conservation manager and assistant who worked on program development. In addition, one customer service person was budgeted to work part time performing energy surveys.

The Palo Alto program was the first to be planned under the NCPA grant, and consequently much has been learned regarding the process of establishing such a residential energy conservation program.

Many of the materials developed will be applicable to other NCPA cities as they begin implementing programs. In addition, the Palo Alto home energy consultants will subsequently train other energy specialists from NCPA cities providing those people an opportunity to learn from their expertise.

How Palo Alto's Program Works

The components of the Palo Alto Weatherization Program and how they interrelate are described below.

Home Consultation Service. A home energy consultant, when requested, visits the customer's home and performs a walk-through energy survey in which energy inefficiencies are checked, including insulation levels, air infiltration, and furnace and duct problems. Uses of water and electricity are also examined. For those homes without adequate ceiling insulation, the consultations also include the measurements and specifications for proper insulation installation. The potential conservation measures are later developed into recommendations through calculations based on the customer's actual utility history. The resulting recommendations describe energy and cost savings and payback period for implementation and are sent to the resident in a folder with related backup information. This allows the customer to decide which measure(s) is the most cost-effective to implement.

Do-It-Yourself Packet. For the many people who are interested in "weatherizing" their homes but who prefer to do the work themselves, the Utilities Department provides a "Do-It-Yourself" packet which explains the different types of insulation available, how to install it, tips on weatherstripping and caulking, etc. At the time of the home consultation visit, the home energy consultant offers a copy of this packet to those interested. Copies are also available at libraries, community centers, and other public facilities, as well as to anyone upon request.

Insulation Installations by Outside Contractors. Homeowners requesting this service receive a utility inspection of their insulation requirements. The inspector determines the amount of insulation required to bring the ceiling up to R-19 (the state standard for new residential construction in the Palo Alto climate zone), the cost of the installation, and other specifications for the contractor to meet in the installation. The homeowner is then given the option of signing a contract authorizing the installation and the billing on his/her monthly utility bill. If the homeowner's credit rating is satisfactory, the City subsequently notifies the contractor to arrange a date for the installation. Upon completion of the job, the contractor submits an invoice to the City, along with a signed acceptance of the job by the homeowner, at which point the City pays the contractor. The next utility bill includes the monthly payment stipulated in the homeowner's contract.

Insulation contractors were invited to participate in the program through the City bidding process and contracts were awarded to the lowest responsible bidders as prescribed in the Municipal Code. The bidding process is required of all local agencies by California law. In order to encourage more local and small companies to participate, the bid invitations were sent to companies located in the area between Sunnyvale and Redwood City on the San Francisco peninsula. However, qualified contractors from outside this radius were included on request. In order to assure quality control, a set of stringent requirements for the participating contractors was applied. These requirements included bondability, insurance coverage, prior approval of materials to be used, conformance to City specifications, and a background check of past experience, previous names used by the company, bankruptcy history, and previous installations. All insulation materials used must have been tested and approved by the Underwriters' Laboratory, as well as approved by the Electric and Gas Industries Association. The City inspected at least one job performed by each participating contractor prior to contract award and currently inspections are performed for any homes for which a major complaint is received. At least 10 percent of all installations are inspected routinely. Cause for deletion of a contractor from the program includes the following:

- the use of nonapproved materials in installations
- consistent complaints about the insulation jobs
- poor workmanship
- failure to follow the signed contract

Utility Financing of Insulation Installations. Insulation installations done under the Weatherization Program mechanism may be financed through the utility with payback on the utility billing system. Interest rates for the loans are set at one percent above prime, not to exceed eight percent, which would approximate the same rate of return the utility would otherwise gain on general investments, as well as cover administrative carrying costs. Details of the financing package are described below.

Legal Precautions: The appropriate legal forms prepared by the City Attorney's Office are supplied to the applicant, including Truth-In-Lending Disclosure Statements and Right of Rescission Notices.

Eligibility: The Utility credit rating system is used to determine eligibility of a homeowner who requests a loan. Applications with bad histories of payments do not qualify. Tenants wishing to participate must have their landlords sign the contract.

Loan Size and Financing Means: For a typical Palo Alto house, insulation to R-19 standard costs between $250 to $450. The City consulted with local banks in the area and found that generally banks are not interested in financing such small amounts. The City set a limit of $550 for the loan. It is hoped that by setting a maximum loan of $550, more homeowners will be able to take advantage of the money available for this purpose. If a very large house requires an amount higher than this limit, a down payment of the difference may be made.

Payment Options: Four payment options are offered:

- Immediate cash payment upon completion of installations.
- Pay off the balance the first billing period after installation is complete with no finance charge.
- Pay off the balance in two equal monthly installments with no finance charge.
- Pay off the balance in up to 60 months with an annual finance charge of prime rate plus one percent interest, not to exceed eight percent.

The fourth option importantly allows more low-income homeowners to participate since the added insulation charge is offset by the decrease in the bill resulting from the insulation. Low-income residents are also referred to the Citizens Home Energy Conservation Project of Santa Clara County to determine eligibility for its free insulation program.

Nonpayment Problems: The City offers residents an unsecured loan, which does not require collateral. It is hoped that by making simple and uncomplicated loans available, more people will take advantage of the opportunity to insulate. All other public utilities contacted conducting similar programs have indicated that nonpayment is not a big problem. Typically, less than one percent do not pay, which is consistent with a bank official's statement that homeowners making home improvements are good risks. This fact, coupled with the use of the utility credit rating system as a qualifying factor, should minimize the nonpayment risk. All loans are due to be paid in full upon sale of the house.

Certification of Weatherized Homes. All homeowners who have completed insulation of their homes, either through the City's program or on their own, are able to request inspection and certification of the installation. The certification may be displayed in the home as it is now for new homes, and will be useful to the homeowner for tax credits and for increased value at resale.

Benefits

The weatherization program benefits both the homeowner, the municipal utilities, and the City as a whole. Palo Alto residents who participate in the program rather than insulate on their own benefit in several ways:

- The homeowner knows that he or she is obtaining a quality insulation job performed by a contractor who has demonstrated reliability to the City, and who has agreed to follow the stringent requirements demanded by the program.
- Homeowners pay a price which has been obtained through the City's bidding procedure (plus two cents per square foot added to cover administrative costs), a price which may be lower than a contractor could otherwise offer an individual homeowner.
- The City is able to provide a loan at a lower interest rate than would be available elsewhere.
- Since the City has access to specific utility usage histories, the customer is in a position to receive sound advice with respect to cost effectiveness of conservation measures.
- By participating in the weatherization program, the customer only has to deal with one trustworthy entity. The need for the homeowner to obtain several estimates, to check contractor reliability, insurance requirements, etc., and to arrange financing is eliminated. Consequently, much time and frustration for the customer is saved.

The Palo Alto program also benefits the other NCPA utilities since much of the program developed can be adapted to fit into their new programs.

Steps Taken to Develop the Program

Palo Alto's energy conservation program manager considered the idea of developing and implementing a residential conservation program for several months. An increase of one person to the staff helped create the personpower necessary to proceed with the idea. Several days were spent trying to synthesize the elements of existing utility programs into one which would work in Palo Alto. By studying these programs being offered by Southern California Gas Company, Michigan Consolidated Gas Company, and others, and by working directly with the State Energy Commission staff, the ideas for the general components and program elements were finalized.

In October, 1977, a concerted effort was made to initiate the development of the procedures and processes that would be need to implement these components. Steps taken to proceed are described below:

- An outline was developed in which every program element was specified with its approximate implementation time. Composing a time frame outline forced the staff to consider each step necessary for the whole program to work.
- Meetings with all division heads whose departments might be affected by the new program were conducted. For example, consultations were held with the Controller's Office to set up an accounting system; the Attorney's Office to check out

legal aspects of such a program; the computer programmer to determine the feasibility of putting monthly insulation charges on the utility bill; the credit manager regarding the utility credit-rating system; the utility business manager to determine how an additional new utility service might impact an already-too-busy customer service department; the purchasing department to obtain input on the City's contract procedure.

The meetings proved to be extremely beneficial to the staff in helping shape departmental responsibilities in implementing the residential program. For example, it was quickly learned that the Building Department did not have the staff to provide attic inspections, as was originally proposed. Therefore, another option had to be considered to provide this component of the program (the use of home energy consultants).

- A meeting was held with two prominent local insulation contractors, to gain input for the insulation portion of the program. The conservation staff believed that in order to have a successful insulation component, it was essential that local contractors want to participate. It was hoped that the contractors could give the staff ideas to structure that program so that this participation would occur. [This meeting ultimately determined the structure of the insulation program. Originally the staff planned to allow qualified contractors to contract with the homeowner directly. However, these two contractors convinced the staff that a key ingredient to a safe and successful program was that the City maintain absolute control in the field. At that point the staff decided to become the contracting agency with both the homeowner and with the contractor.]
- The conservation staff worked out a budget and determined personpower requirements for the program. The NCPA funding was incorporated into this process and the appropriate budget amendments were prepared.
- Meetings with local banks were held to discuss a private lending institution financing arrangement for the insulation installations. These meetings indicated that banks generally are not interested in lending such small amounts of money to individual homeowners.

Concurrent with the actual program development, the conservation staff prepared a report to the City Council requesting authorization to develop and implement the weatherization program and requested the passage of a budget amendment to reflect the receipt of grant money. The establishment of a $100,000 fund to be used for paying contractors and for receiving monthly payments was also requested in the staff report. The report was presented to the Council, which passed it after much discussion.

After City Council approval, the staff moved full-speed ahead in the weatherization program development. In order to more concisely describe this development, below is a discussion in terms of individual program components: home energy and insulation program development; internal procedures; do-it-yourself packet information development; program publicity; and Palo Alto's training program. Problems encountered along the way and other issues to consider will also be described.

Home Energy Surveys and Insulation Program

Four staff members (the program assistant, two home energy consultants, and one customer service person) received extensive insulation training by the Sacramento Municipal Utility District and training in home energy surveys by the State Energy Commission.

One staff person visited the Salt River Project in Arizona to study its insulation program and administrative procedures.

Materials necessary for the home energy consultants were ordered:

- ladders
- flashlights
- dropcloths
- face masks
- tape measures
- clipboards
- carrying cases
- uniforms

- inexpensive calculators
- scales to weigh insulation

Survey forms, brochures, contract forms, legal forms (including Truth-In-Lending and Right of Rescission) were developed, as well as instructions to the homeowner and contractor.

Bid specifications for contractors were prepared (after much research) for use in the bidding process. The specifications described the types of products allowed and the procedure to be followed by the contractors in the process.

Notebooks were prepared by the home energy consultants which included samples of weatherstripping, brochures on insulation, caulking and weatherstripping, sample contract forms, instructions for insulating hot water heaters, a chart of R values for various types and thicknesses of blown insulation, and other miscellaneous materials which each home energy consultant thought might be useful.

Internal Procedures

Prior to implementing this comprehensive conservation program, the staff prepared a draft of detailed procedures which outlined the entire process for all phases of the program. These included overall procedures and step-by-step processes specifically for the clerk, program assistant, and for the home energy consultants.

A data collection and updating system was established in coordination with the State Energy Commission. The system monitors progress of the program by compiling statistics on number of visits made, number of contracts sold, number of insulatable houses, and percentage of sales. These reports are compiled by congregating data from forms which the home energy consultants turn in each week. The results of each week's figures are then added cumulatively so that at any one time comprehensive data can be available regarding the status of the program.

It was necessary to reprogram the City's computer in order to include the monthly utility bill payback option in the program. This reprogramming took approximately 100 hours and cost about $1500. A procedure to input the computer with monthly billings for insulation was also developed.

Do-It-Yourself Information

The do-it-yourself kit represents an extensive effort by the conservation staff to encourage homeowners to weatherize. A goal of the kit was to make home weatherization a project which could be carried out indpendently. As such, it was determined that that kit should be entirely comprehensive and include information on all major conservation measures applicable to Palo Alto. It included a home energy survey form, brochures on weatherstripping and caulking, insulation, water heater insulation instructions, lists of local insulation contractors, lists of establishments which carry energy conserving devices, lists of establishments which rent insulation blowing machines and more.

Program Publicity

Program development was completed by May, 1978, just three months after City Council approval. The next step was to publicize the availability of the program. Other utilities with similar programs indicated that the most effective publicity to use was utility bill stuffers and/or special utility return tear-off envelopes ("bang-tail" envelopes). These envelopes are designed in such a way that the desired publicity is printed on the envelopes on a section which must be torn off before the envelope can be sealed, thus assuring that the message is seen. The first bill stuffer was sent out in May and response was overwhelming. Over 500 requests came in which created over a three-month backlog of surveys to be performed. In August, the tear-off envelope was sent which again created a huge backlog. Other utilities control such backlogs by mailing bill inserts in a small number of billing cycles per month. Other publicity has been modest—a few articles in the newspapers, one short segment on a local news program, and a doorhanger with insulation information printed on it. None of these last efforts have produced significant results. Clearly, the bill stuffers and tear-off envelopes are the most effective publicity efforts tried in Palo Alto.

Training Program

One of the key benefits of Palo Alto's Weatherization Program is the expertise which has been gained through the program development and implementation phases. The City is now in a position to share this expertise with other utilities contemplating weatherization programs. Palo Alto has developed a comprehensive training program for

Lodi, Santa Clara, and other NCPA cities, which was offered for the first time in December, 1978. It includes:

- The philosophy of the role of an energy consultant
- An overview of energy use and supply
- Heat loss calculations
- Insulation
- Weatherstripping and caulking
- Heating systems
- Appliances
- Swimming pools
- Water heating
- Lighting
- Reducing summer temperature
- Field training on home energy surveys

This training is scheduled to last one week and will be adaptable to any NCPA city.

Issues Encountered

Considering the innovative and creative aspects of the Weatherization Program, very few problems were encountered in setting it up. However, a few issues did arise which were significant.

One of the major issues which the City Council questioned involved the concept of the City competing with the private sector in the insulation business. The staff pointed out that the California Public Utilities Commission was requiring the private utilities under its jurisdiction to develop insulation programs, including installation and financing.

The City Council also questioned the concept of the City lending money to finance insulation. Although the staff had indicated that banks were not interested in financing such amounts of money ($250-$550), the Council directed the staff to research this point more thoroughly. Consequently, a letter was prepared and sent to all lending institutions in Palo Alto requesting them to participate in the program, and to prepare proposals outlining the terms under which they would lend money to homeowners for the purpose of insulation.

Two banks responded, both of which desired credit card-type rates of interest for lending money. Clearly, this high interest rate (18 percent) was not in line with the concept of "encouraging homeowners to insulate." This additional step delayed the program implementation approximately one month.

An issue which arose early in the program dealt with the disenchantment of contractors who were not accustomed to participating in the City's bidding process. The City Purchasing Agent advised the conservation staff that contractor selection would have to be made on the bidding process, due to provisions in the Municipal Code. A significant amount of paperwork is required as well as bid bonds, performance bonds, insurance requirements, etc. Many small contractors were not used to dealing with this degree of paperwork, and therefore elected not to participate. However, ultimately, the bidding process produced well-established, reputable contractors who were able to bid low based on the expectation of a high volume of business and on the fact that their sales efforts were eliminated.

Because significant issues were questioned in the weatherization program, the staff was directed to bring the program back for Council review prior to January, 1979.

Issues to Consider

The purpose of this section of the report is to provide a brief description of some issues to be considered when implementing a weatherization program.

- Control the degree of mass-media advertising of the program so that the backlog of energy survey requests does not become too large. A backlog of one month would be the largest a utility should allow. If it exceeds this time period, customers tend to think the utility has forgotten them, or they lose interest in participating at all.

- Schedule appointments for home energy surveys no longer than one week ahead. Many customers forget appointments made in advance of one week, and the percentage of "no shows" increases. This results in an ineffective use of the home energy consultant's time.
- Keep the home energy consultants on schedule with their duties. Follow-up is an essential ingredient for effective insulation sales. It is also important to send energy recommendations to the homeowner soon after completion of the survey so the homeowner does not forget which measures were recommended.
- Devise a system to keep track of payments of each insulation customer. Record the interest each customer has paid during the year and report it to the customer for income tax purposes.
- Establish a routine system for reporting on the status of the program. A weekly or bimonthly report helps the program manager make necessary modifications to the program by being able to identify program deficiencies early.

GREENVILLE UTILITIES, NORTH CAROLINA

"No Exemption From Commitment to Conservation"

by Reese Helms, Manager
Office of Energy Conservation and Management
June, 1978

The National Energy Act is expected to contain a provision that electric utilities whose annual sales are in excess of 750 million kWh must make available various energy conservation services to their customers. Although providing these services will not be mandatory for Greenville Utilities and many other smaller systems, there are several ways to hang yourself, and most customers—hard hit by escalating energy prices—are more than willing to supply a generous length of rope.

Residential users of electrical energy do not shape their attitudes and opinions about the local utility according to the size of its service area. They can hate 'em big, and they can hate 'em small. They can be particularly mistrustful of the utility which, on the one hand, sells them all of the kWh they can whirl through the meter, but on the other hand appears to be unconcerned about whether they are stretching the value of their energy dollars.

That dark cloud on the horizon is a mixture of a little consumerism and a lot of frustration about what is happening to the size of the average monthly electric bill. At Greenville Utilities, we felt it was time to make the energy conservation commitment.

Greenville Utilities Commission serves 22,000 customers in Pitt County, an agriculturally oriented area of flatland in eastern North Carolina. With a population of 35,000 plus, Greenville is experiencing relatively rapid growth as industry moves in and as East Carolina University establishes a four-year medical school. Our decision to create a full-time energy conservation department was based partly on this rapid growth, but mostly it was based on the needs of our customers.

In the nine months since the inception of our Office of Energy Conservation and Management, we have built the foundation for a sustained program constructed around three primary facets: education, service, and contribution. Broadly speaking, our goals are:

- Better educate our customers about the wise and efficient use of all energy forms.
- Provide services which will help our customers reach their individual energy conservation goals.
- Contribute to the objectives set forth in the National Energy Plan by providing local leadership in energy conservation and management, and through research aimed at acquiring factual, and locally applicable data on energy cost and consumption.

It has taken a while to determine just what needs exist within the community we serve, how we can best meet those needs, and how we can optimize our resources to meet community needs effectively, within the limits of budgetary and manpower constraints.

While we've been poking around trying to find our way, we have managed to accomplish some meaningful work. We've responded to hundreds of questions from our customers about saving energy ("If I buy a timer for my water heater, will I save $10.38 each month like the ad says?").

We've conducted residential and commercial energy surveys; made dozens of presentations to school groups, civic clubs, etc.; drafted a format for an Energy Efficient Home Award program; and conducted in-house training sessions for our employees as part of our own energy management program. There are a handful of other projects "in the making."

Quite a bit of time and effort has been invested in "ground work." Training of staff, establishing contacts, locating sources of information, and the like are all necessary and time-consuming activities which must precede the "high visibility" programs.

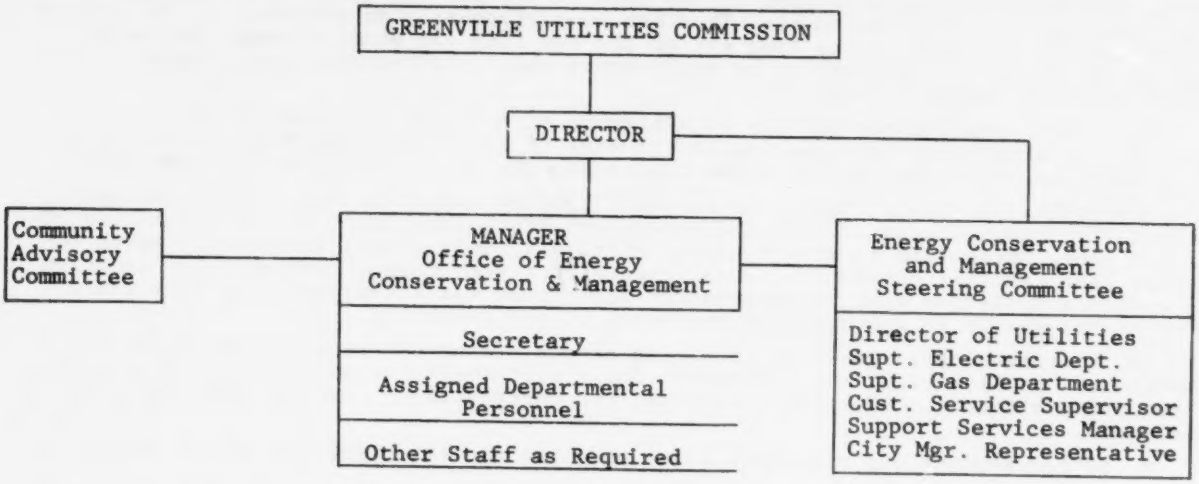
Like it or not, visibility is extremely important. The folks can't see the new heat recovery system that will save a lot; they can see the utility's outdoor lighting reduced to a few frail beams and nod approvingly. It is generally agreed that a public utility—big or small—must start by "getting its own house in order" before assailing the public with a barrage of energy awareness words and events.

Recognizing the importance of visibility and the necessity of taking one step at a time, Greenville Utilities moved forward with its commitment.

Getting Started

We are one of two public utility systems in North Carolina governed by a completely separate body rather than by the City Council. Our six utilities commissioners are appointed by the City Council, with one slot reserved for the city manager. Thus, there is a governmental link between town and utilities management, although the dichotomy is maintained throughout all decision-making areas. The proposal to establish and maintain a full-time energy conservation department was presented to the Commissioners and unanimously approved.

We borrowed some ideas from here and there on what the organizational setup should be like for our conservation program. What came out is shown on the chart below.


GREENVILLE UTILITIES COMMISSION
DIRECTOR
Community Advisory Committee
MANAGER Office of Energy Conservation & Management
Secretary
Assigned Departmental Personnel
Other Staff as Required
Energy Conservation and Management Steering Committee
Director of Utilities
Supt. Electric Dept.
Supt. Gas Department
Cust. Service Supervisor
Support Services Manager
City Mgr. Representative

The secretary is more like an assistant and has brought order out of the chaos quickly created by asking for, and receiving literature from 200 or so government agencies, utilities, and private companies. She helps field questions from the public about energy conservation and about our volunteer load management program.

The energy projects coordinator has various duties. (Give a person a title like this and you can assign him all kinds of things to do.) And the manager manages to stay out of the way of the other two so that the work can get done.

The secretary was hired two months after the manager, which was as long as he could tolerate keeping his own files. The projects coordinator came along five months into the program.

Funding is critical and may be the major reason why many systems do not make the full commitment to energy conservation. The budget, a delicate instrument, can be augmented in a number of ways, particularly when Federal money is available to ease the pain. We applied for a $10,000 grant under the Energy Conservation and Production Act and were awarded $7,450 through our State Energy Office—not an awesome figure, but helpful when your program is in the start-up phase.

The first year of the new department had to be budgeted by guesswork. The second year is budgeted on guesswork, plus ten percent. We guessed at $50,000 for fiscal 1977-78, broken down as follows: salaries, $30,000; public communications, $10,000; professional services, $5,000; and supplies, $5,000.

Currently, we are running about ten percent under budget, and there is no feeling of urgency to quickly dump the remaining appropriation in order to justify a bigger chunk for next year. In fact, had the thermographic flyover been successful (weather and equipment problems impaired the quality of the final prints), we would be ten percent the other way. The professional services item would have been shot to pieces. On the other hand, we're nowhere near spending $10,000 on public communications. Not that we're stingy handing out free literature, we just haven't developed a public communications program that is organized well enough to justify spending that amount.

Flexibility is the key.

What Can We Do?

After the concept of adding a new department is approved, and after the budget has been sufficiently massaged to provide the necessary funds, the greatest challenge lies ahead: how to spend the time and the money so that it will do the most good. Three questions need to be answered: What should we do? What can we do? and How can we do it?

If the conservation of energy were the sole organizational objective, we might well moralize to the point where we determine that we should do all sorts of things—like change laws so that landlords would have to make their dwellings more energy efficient (or at least livable, in some cases) regardless of the cost. We might take batt in hand and go forth to insulate all standing structures. Or, perhaps we should require our customers to pass a rigid test on how to conserve energy before providing them with electrical service (and get a written pledge that they will not go away for a three-week summer vacation and later complain that their bill went up). The list is endless, but it's the second question—What can we do?—that gets you every time.

After preparing a list of identifiable community needs, we dug in to determine which of those needs we could realistically meet, and how we would meet them. The analysis goes something like this:

Need: Our residential customers need to understand the variables which account for their kWh consumption for a given month, and how it is measured.

What can we do? We can attempt to better educate them, and we can show them what structural and mechanical factors help account for a pattern of energy consumption within their homes.

How can we do it? We can distribute literature; give telephone and personal consultations; conduct an energy survey of their homes; utilize infrared thermography; teach their children, who in turn will teach them; and communicate through the electronic and printed media.

If a particular need is strong enough and the means to help meet the need are readily identifiable, then there is a strong justification for a capital expenditure and/or an increase in budget. For example, our residential customers are becoming insistent upon the availability of someone who will inspect their homes to determine "what the problem is." ("I couldn't possibly have used this much electricity.") Quite often, behind an initial high bill complaint is a desperate plea for help. The customer knows that the meter is probably accurate and that just maybe the meter readers have vision in at least one eye, so it's got to be something else.

We propose to add a "specialized" person to our Energy Conservation Department staff who can conduct residential and commercial energy surveys. In an organization of our size, however, specialization means that you are wearing only three or four different hats instead of five or six. This person would have other responsibilities, including in-house energy management activities and working with builders to help implement an Award program that is being developed to promote the building of more energy efficient homes.

Use the "Gratis Resource Pool"

The most frustrating fact which we've had to face is that we can't do everything that needs to be done.

The most reassuring fact which we have discovered is that our town is full of people who care about our nation's energy problems, who support our efforts, and who are willing to work to help us. The availability of concerned citizens is particularly important to an organization whose need to expand is always just one step ahead of the availability of capital to support the expansion.

For most public utilities, it will take more resources than the budget allows to get the job done the way you want it done. Tapping the "Gratis Resource Pool" will help make up the deficit. This is the resource pool comprised of companies, agencies, and individuals at the local, state, and national levels who are ready and willing to help.

For example, we are planning to build a mobile energy conservation display unit. A group of product design students undertook the design of the display unit as a semester project. Students in several vocational curricula at the local technical institute will construct the unit as a class project. Several manufacturers have expressed a willingness to donate some of the major cost items, and our State Energy Office is interested in sharing some of the mobilization costs when the unit is operational. In short, what would otherwise have been a cost-prohibitive project is now a distinct possibility through the use of the resource pool (gratis, of course).

We are particularly fortunate to have a major university as well as a two-year technical institute located in our service area. The technical institute is developing a two-year Energy Technology program which will supply us with a steady stream of student interns capable of assisting in the implementation of our education and service programs. Likewise, several departments at the University will be working with us to establish internship positions within our Energy Conservation Department.

The State Energy Office can lend much-needed assistance. Our State Office has supplied us with a truckload of energy conservation literature free for the hauling, and has helped us keep abreast of the grant money market, just to name two examples.

It is possible to be engaged in a significant amount of work to promote energy conservation without spending anything other than time. For example, the Department of Energy was kind enough to loan us their Home Energy Cost Savings Calculator for several weeks, during which time hundreds of our customers enjoyed discovering the relative cost savings to be pocketed by employing various energy conservation strategies. The local TV station even got into the act and helped stir up public interest in the display unit.

The local news media, in fact, have helped us in our quest to be a leader in "Promoting Energy Conservation—on a Budget." The newspaper frequently features our articles, and occasionally throws in a spicy editorial to keep the citizens "energy conscious." Several radio stations broadcast our messages on a public-service basis, and we get invited as guests from time to time on both radio and television talk shows. It all helps, and it doesn't dent the budget at all.

When you add up all the local organizations, agencies, companies, schools, and concerned citizens, you have a sizable Gratis Resource Pool to work with--and it is all conveniently located in your own service area. Throw in the possibilities which exist at the state and national level, and the job begins to look more and more manageable—and affordable.

Because conservation provisions of the National Energy Act will not affect Greenville Utilities, we could perhaps delay for years the implementation of an energy conservation program before being forced to comply with a Federal mandate. But such a policy would miss the point altogether. The need exists now. Our customers are getting caught in an avalanche of rapidly rising energy costs, conflicting information about what saves energy and what doesn't, and non-corroborating reports on the availability of conventional fuels. The question of how far the public utility's responsibility must reach hasn't yet been answered to the public's satisfaction.

We feel that our responsibility goes beyond the delivery of electrical energy to the customer's point of use. It goes at least as far as helping the customer learn how to use that energy in the most efficient manner possible.

CEDAR FALLS UTILITIES, IOWA

Procedures and Criteria Used In Residential Energy Audit Service

I. THE APPOINTMENT

A. The customer will request a home energy audit because of an interest in energy conservation or a desire to make the home more comfortable.

The request is normally stimulated from:

1. Talking with friends who used the audit service.
2. Information in the customer newsletter bill insert.
3. Radio message or newspaper ads.
4. The result of a Business Office referral in response to a high bill inquiry.

B. Once the call is received, an appointment is scheduled. The audit will usually take approximately one hour and will depend on the house structure and the number of questions asked by the customer. Special appointments are sometimes made after regular working hours for the customer's convenience.

II. THE AUDIT PROCEDURE AND METHODS

A. Park on the street rather than in drive. This eliminates worries about backing into a child, over toys, or blocking the driveway.

B. Invite the customer to walk along with you so things can be pointed out on the audit.

C. Exterior of House

1. Check the caulking at window and door frames, overhangs, sill plate, trim corners, utility openings (such as for wires installed through siding, water faucets, air conditioning, or sump pump hoses) and caulk at foundation.
2. Note number and size of soffit, roof, gable and ridge vents.
3. Check the general condition of the structure (tuck-pointing is suggested on brick or stucco, if needed).

D. Interior of House

1. Basement
    - a. Check windows (suggest storms or plastic covering).
    - b. See if R-11 insulation is in box sill (use flashlight to point out exact area).
    - c. Note length of hot water runs—if excessively long, suggest wrapping with insulation.
    - d. Check dryer vent—should be vented for summer use.
    - e. If basement is heated, suggest R-7 or R-8 wall insulation.
    - f. If basement is unheated, suggest R-19 insulation in ceiling.
2. Crawl Space
    - a. See if R-11 insulation is in box sill.
    - b. Check for a vapor barrier on ground, wall, or floor.
    - c. Recommend R-7 or R-8 insulation in walls, or . . .
    - d. Install R-19 insulation under floor.
    - e. Note any hot water pipes or heat runs that should be insulated.
    - f. Check for inlet and outlet ventilation (to remove damaging moisture in winter, and heat build-up during summer).
    - g. Check heating unit—suggest changing or cleaning furnace filters during winter each month, and during cooling season, every six weeks. Furnace should be inspected and maintained periodically by a service professional.

        h. Check water heater—use flashlight to determine the temperature setting. Also, at kitchen sink, water temperature is taken with a thermometer. Water heaters are often not calibrated accurately. Explain how the water heater thermostat may be changed, if necessary.

    3. Living Area

        a. Check location of the heating and cooling thermostats. Look for the effect of the sun, lamps, or humidifiers that may alter the thermostat temperature.

        b. Check the furniture arrangement to see if there is any blockage of heat runs or cold air returns.

        c. Inquire what the thermostat settings are for daytime, and night setback. Make suggestions if appropriate.

        d. Fireplace—recommend the use of a glass door enclosure and an outside air intake.

        e. Determine if kitchen and/or bath exhaust fans are vented.

        f. Check weatherstripping on all doors. Check a few windows for weatherstripping.

        g. Measure the relative humidity.

        h. Listen to customer questions or comments on home problem areas. Offer possible solutions.

    4. Attic

        a. Trap door or access panel should be insulated and weatherstripped.

        b. Determine type of present insulation and the depth. Use a ruler to measure.

        c. Determine if there is a vapor barrier.

        d. Light should be seen from vents that were noticed when walking outside.

        e. Exhaust fans should go through roof to the outside.

        f. Check for evidence of moisture problems—rings around nails on roof line, stained boards, frost crystallization on roof line.

        g. If a power fan is used, it should have a humidistat and frost control. This will allow operation during the winter months as well as the summer.

        h. If any home recessed lighting is present, check to be sure it is not covered with insulation.

III. NEEDED EQUIPMENT AND CLOTHING

A. A flashlight is usually essential in an inspection of the attic.

B. A ladder must be carried if the customer does not have an easy access to the attic.

C. A pair of coveralls are recommended, if the conditions are such that protective clothing is needed. This clothing is kept in the car.

D. A hard hat is also carried in the car for personal protection, if needed.

E. Safety shoes or boots are also worn during an energy audit.

IV. FOLLOW-UP

A. The energy auditor makes recommendations throughout the audit to the customer.

B. A follow-up letter is sent the next day with a summary of the recommendations that were made.

C. A copy of the worksheet and letter is kept in the Energy Services Department, so it may be used to answer future questions regarding this residence.

best copy available